COPY #1

INSTRUCTION MANUAL

MODEL 132
VCG/NOISE GENERATOR

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APPLIED PHYSICS LABORATORY
UNIVERSITY OF WASHINGTON

WAVETEK

Product Improvement Notice

Wavetek maintains a continuing program to make improvements to their instruments that will take advantage of the latest electronic developments in circuitry and components.

Due to the time required to document and print instruction manuals, it is not always possible to incorporate these changes in the manual.

Wavetek has manufactured your instrument, using metal film 1% tolerance resistors in place of 5% carbon resistors, wherever practical. This results in a substantial improvement in the overall performance of your instrument. Therefore, there may exist a discrepancy between the resistor used to manufacture your instrument and the resistor called out in the Parts List and Schematic Diagrams in this manual.

If field replacement of an affected resistor does become necessary, replacement may be made in accordance with the manual call outs. Wavetek, however, recommends replacement with the same type of resistor used in the manufacture of your instrument, whenever possible.

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SCOPE OF MANUAL

This manual contains instructions for operating, testing, and maintaining the Wavetek Model 132 VCG/Noise Generator. The Wavetek product-improvement program ensures that the latest electronic developments are incorporated into the Wavetek instruments by the addition of circuit and component changes as rapidly as development and testing permit. Due to the time required to document and print this manual, it is not always possible to incorporate these changes into the manual. In this case, data will be found on engineering change sheets at the back of the manual. If there are no change sheets, the manual is correct as printed.

SCOPE OF EQUIPMENT

The Model 132 is a source of analog and digital noise, as well as a precision source of sine, triangle and square waveforms. Noise outputs, or waveforms can be used individually, or combined to provide selectable, calibrated signal-to-noise and noise-to-signal ratios to +60 dB. Waveforms can be varied over a frequency range of 0.2 Hz to 2 MHz. Length of the digital sequence is selectable to a maximum of $2^{20} - 1$ bits. Clock rates, variable from 160 Hz through 1.6 MHz, give added versatility to the noise generator. These clock rates allow selectable noise bandwidths variable from 10 Hz to 100 kHz.

SECTION 1
SPECIFICATIONS

VERSATILITY

Waveforms
Sine , square , triangle waveforms and analog noise , or digital noise

Frequency Range of Signal
0.2 Hz to 2 MHz in 6 decade ranges

Ranges

X10	0.2 Hz to 20 Hz
X100	2 Hz to 200 Hz
X1K	20 Hz to 2 kHz
X10K	200 Hz to 20 kHz
X100K	2 kHz to 200 kHz
X1M	20 kHz to 2 MHz

Function Outputs
Sine , square , and triangle selectable, with 60 dB step attenuator in 10 dB steps and overlapping calibrated vernier; 50Ω output impedance, 20 V p-p into open circuit and 10 V p-p into 50Ω load from 50Ω source impedance.

Sync Output
Greater than 1 V p-p square wave into open circuit at 600Ω output impedance.

DC Offset
±5 V offset (±2.5 V offset into 50Ω load) controlled from rear panel; peak amplitude limited by the dynamic range of the amplifier output.

VCG – Voltage Controlled Generator
Frequency of the generator may be dc-programmed, or ac-modulated by external 0 to ±5 V signal. Voltage control circuitry is capable of 1000:1 deviation. The VCG amplifier has a 100 kHz bandwidth and a slew rate of 0.1 V/μs. The instantaneous frequency is the result of the sum of the dial setting and the externally applied voltage.

Stability

Short term	±0.05% for 10 minutes
Long term	±0.25% for 24 hours

Percentages apply to amplitude, frequency, and dc offset.

HORIZONTAL PRECISION

Dial Accuracy
±2% of full scale, 1 Hz to 2 MHz

Frequency Vernier
One turn equals 1% of full scale.

Time Symmetry
±1% through X100K range

VERTICAL PRECISION

Sine Wave Frequency Response
Amplitude change with frequency less than:
0.1 dB from 0.2 Hz to 200 kHz
0.5 dB from 0.2 Hz to 2 MHz

PURITY

Sine Wave Distortion
Less than:
0.5% on X10, X100, X1K, X10K ranges
1.0% on X100K range
2.0% on X1 MHz range

Square Wave Rise and Fall Time
Less than 100 ns

NOISE

Outputs
Pseudo-random analog or digital noise with a maximum of 20 V p-p excursion (open circuit) with 60 dB step attenuator in 10 dB steps and overlapping calibrated vernier.

Sequence Lengths
Push buttons on the front panel provide a sequence length of $2^{10} - 1$, $2^{15} - 1$, or $2^{20} - 1$.

Noise Clock Frequency
Switch selectable noise frequencies are listed below.

Clock Frequency	Analog Noise Bandwidth
160 Hz	10 Hz
1.6 kHz	100 Hz
16 kHz	1 kHz
160 kHz	10 kHz
1.6 MHz	100 kHz

OPERATIONAL MODES

FUNC Function Mode — Provides the selected waveform at the main output.

S/N Signal-to-Noise operation adds noise to a selected signal of constant amplitude. The signal-to-noise ratio is variable from 0 to +60 dB.

N/S Noise-to-Signal operation adds a selected signal to a constant amplitude noise. The noise-to-signal ratio is variable from 0 to +60 dB.

FM Frequency Modulation — Provides random modulation of the frequency of the generator. The S/N - N/S (dB) ratio control also controls the amount of frequency deviation.

NOTE

When noise is added to the signal output, specifications apply up to 200 kHz and the square wave rise time is derated by a factor of 10. In the clock range of 1.6 MHz, the maximum calibrated signal-to-noise ratio is 30 dB.

ENVIRONMENTAL

Temperature
All specifications listed, except stability, are for 25°C ±5°C. For operation from 0°C to 55°C, derate all specifications by factor of 2.

MECHANICAL

Dimensions
8½ inches wide, 5¼ inches high, 11½ inches deep

Weight
8 lbs net, 12 lbs shipping

Power
105 V to 125 V or 200 V to 250 V, 50 Hz to 400 Hz. Less than 15 watts.

NOTE

All specifications apply for frequencies obtained when dial is between 0.1 and 2.0 and at 10 V p-p into a 50 ohm load.

It is possible to stop the generator from oscillating by applying a negative VCG voltage when the dial is already set at minimum frequency. VCG inputs up to 30 V will not permanently damage the instrument.

SECTION 2
OPERATION

INSPECTION

The following procedures should be performed to assure the user that the instrument has arrived at its destination in satisfactory operating condition. Complete calibration and checkout instructions are provided in Section 4 to determine compliance with electrical specifications.

Checking Visually

After carefully unpacking the instrument, visually inspect the external parts for damage to knobs, dials, indicators, surface areas, etc. If damage is discovered, file a claim with the carrier who transported the instrument. Retain the shipping container and packing material for use in case reshipment is required.

Checking Electrically

NOTE

Instruments are normally shipped connected for 115 V power unless 230 V power is ordered. Refer to the end of this section for conversion instructions.

The steps in this paragraph provide a quick checkout of the instrument operation. If electrical deficiencies exist, refer to the WARRANTY in the front of this manual. The following test equipment is recommended for performing this electrical inspection:

Name	Required Characteristics
Oscilloscope	To 30 MHz
Plug-In	Dual channel
Plug-In	Peak mV measuring capability
Counter-Timer	To 2 MHz with 5-digit resolution

1. Turn FREQ HZ selector to the X1K position. (This connects ac power to the unit and establishes the frequency multiplier.)
2. Depress MODE — FUNC push button.
3. Connect oscilloscope to the 50Ω OUT connector with a 50Ω terminator.
4. Set frequency dial to the 1.0 mark and FREQ VERNIER to CAL position.
5. Set function selector to the ∿ position.
6. Set OUTPUT ATTEN (dB) and OUTPUT VERNIER (dB) to maximum clockwise (cw) position (no attenuation).
7. Check for 1 kHz sine wave with at least 10 V p-p amplitude on oscilloscope.
8. Select ⩘ and ⎍ with function selector and check for 10 V p-p amplitude on oscilloscope.
9. Turn frequency dial from maximum counterclockwise (ccw) to maximum cw position and check for frequency change.
10. Step OUTPUT ATTEN (dB) selector through its range and verify attenuation at each step.
11. Rotate OUTPUT VERNIER (dB) control from maximum cw to maximum ccw position and check for decreasing amplitude.
12. Rotate FREQ VERNIER control and check for frequency change.
13. Set FREQ VERNIER control at maximum cw and frequency dial at 0.02. Set frequency to 20 Hz with counter. Connect a 0 to +5 Vdc input to the VCG IN connector. Slowly increase voltage input from 0 to +5 V and check that frequency of output waveform increases from approximately 20 Hz to 2 kHz.
14. Depress SEQUENCE LENGTH 2^{10} — 1 push button.
15. Set NOISE FREQ HZ selector to the 16K/160K position and vernier control fully cw.
16. Connect a BNC cable from the NOISE SYNC connector (rear panel) to the external trigger input of the oscilloscope.
17. Rotate the function selector to ⎍⎍ and check to assure oscilloscope displays digital noise.
18. Check to assure SEQUENCE LENGTH push buttons vary the bits in the sequence length.
19. Step NOISE FREQ HZ selector through its range and check to assure clock frequency changes. (Use NOISE CLOCK connector on rear panel.)

20. Verify that NOISE FREQ HZ vernier control provides approximately 10:1 variation in clock frequency at the NOISE CLOCK connector (rear panel).
21. Rotate function selector to position and check to assure oscilloscope displays analog noise.
22. Check to assure SEQUENCE LENGTH push buttons vary the length of the sequence of analog noise. (Use NOISE SYNC connector on rear panel.)
23. Connect oscilloscope external trigger cable to FUNCTION SYNC connector (rear panel) and set function selector to position.
24. Set S/N — N/S (dB) selector to −10 position and vernier control fully ccw.
25. Depress MODE — FM push button and check to assure square waveforms are frequency modulated by analog noise.
26. Release MODE — FM push button and depress MODE — S/N push button. Check to assure square wave and analog noise are mixed.
27. Depress MODE — N/S push button and rotate S/N — N/S (dB) selector ccw through each position, checking for reduction in signal level.
28. Verify that the S/N — N/S (dB) vernier attenuates the signal approximately 10 dB between each step of the S/N — N/S (dB) selector.

OPERATING CONTROLS

The operating controls and electrical connections for the Model 132 are shown in Figures 2-1 and 2-2. Each of the following paragraph numbers corresponds to a number appearing in Figure 2-1, front panel, or Figure 2-2, rear panel. The listing below discusses each control and its function.

FRONT PANEL

1. **FREQ HZ/PWR OFF** — Selects one of six decade ranges from X10 to X1M for generator frequency. This value multiplied by the frequency dial setting (3) gives the output frequency of the generator. Extreme ccw rotation will place the switch in the PWR OFF position, turning off all power to the function and noise generators. This control has no affect on the noise frequency.

2. **FREQ VERNIER** — Allows precision electronic control of the signal output frequency. A full turn of the control is approximately equal to 1% of full scale. When turned to the full cw position (CAL), settings on the main dial will be calibrated.

3. **Frequency Dial** — Allows coarse control of the signal output frequency.

4. **Frequency Index** — Indicates the frequency dial setting (3) by reading the dial position opposite the scribe line on the frequency index. The index is illuminated when power to the unit is on.

5. **Function Selector** — Selects the desired function or noise output. To select , , or waveforms, or or noise, the FUNC push button (7) must be depressed.

6. **OUTPUT VERNIER (dB)** — Provides vernier control of 0 through −20 dB from the OUTPUT ATTEN (dB) setting (12). This is the fine adjustment for the output signal and will attenuate signal and noise.

MODE

7. **FUNC** — When depressed, this control allows the selected waveform or noise, as determined by the position of the function selector (5), to be present at the 50Ω OUT connector (11). This push button must also be in the depressed position for the frequency modulation mode (10).

8. **S/N** — Depressing this push button allows a calibrated amount of analog noise to be added to the selected signal, either , , or wave. The signal-to-noise ratio (S/N) is determined by the S/N — N/S (dB) attenuator control (13). When in this mode, the peak to peak signal amplitude is reduced internally, since adding noise to the signal would overdrive the output amplifier.

9. **N/S** — Depressing this push button allows a calibrated amount of the selected signal, either , , or wave, to be added to the analog noise. The noise-to-signal ratio (N/S) is determined by the S/N — N/S (dB) attenuator control (13). When in this mode, the peak to peak signal amplitude is reduced internally, since adding the signal to the noise would overdrive the output amplifier.

Figure 2-1. Operating Controls, Front Panel

10. **FM** — Depressing this push button along with the FUNC push button (7) allows the selected signal, either ∿ , ∿ , or ⎍ wave, to be pseudo-randomly frequency modulated, or jittered. The modulating signal is provided by pseudo-random analog noise, and the S/N — N/S (dB) controls frequency deviation. The bandwidth of the modulating signal is controlled by the NOISE FREQ HZ selector (15) and vernier (16).

11. **50Ω OUT** — Provides the selected generator output function. The generator may operate into an open circuit providing 20 V peak to peak maximum, or into a 50Ω load providing a 10 V peak to peak output.

12. **OUTPUT ATTEN (dB)** — Attenuates the output (both signal and noise) from 0 dB to −60 dB in six calibrated 10 dB steps according to the following table:

Step Attenuator Position	Output peak to peak into 50Ω Load	
	Maximum Vernier fully cw	Minimum Vernier*
0 dB	10 V	1 V
−10 dB	3 V	0.3 V
−20 dB	1 V	0.1 V
−30 dB	0.3 V	0.03 V
−40 dB	0.1 V	0.01 V
−50 dB	0.03 V	0.003 V
−60 dB	0.01 V	0.001 V

* The values in this table are approximate. The OUTPUT VERNIER (dB) (6) will reduce the output approximately 20 dB in all cases, as shown.

13. **S/N — N/S (dB)** — In the S/N mode, this control attenuates the analog noise from 0 to −50 dB in five calibrated 10 dB steps. The selectable signal

amplitude remains constant, thus giving calibrated 0 to −50 dB signal-to-noise ratios. In the N/S mode, the signal is attenuated with the noise remaining unchanged, thus giving noise-to-signal ratios from 0 to −50 dB. The steps for this control are indicated in black numerals on the front panel.

14. **S/N — N/S (dB) Vernier** — Allows a calibrated fine adjustment of the S/N — N/S (dB) step attenuator (13). This control is continuously variable over at least a 10 dB range. When added to the coarse control (13), this amount equals the total S/N or N/S ratio. Approximate values of attenuation are indicated in red numerals on the front panel.

15. **NOISE FREQ HZ** — This range control selects the clock frequency, or bandwidth for the digital, or analog noise, respectively. When using the digital noise function, clock frequencies from 160 Hz through 1.6 MHz (indicated in black numerals and letters on the front panel) are available. When using analog noise or the S/N, N/S modes, the bandwidth of the analog noise may be selected from 10 Hz to 100 kHz (indicated in red numerals and letters on the front panel). In the FM mode, this control establishes the bandwidth of the analog noise used for frequency modulation. There are four detent positions with an overlapping vernier control (16). With the vernier in the full cw position, the clock frequency, or bandwidth, is equal to the value printed to the right of the detent mark.

16. **NOISE FREQ HZ Vernier** — As mentioned in number 15, this control provides a continuous, fine control between the detent positions of the coarse control. When in the full cw position, the clock frequency, or bandwidth, is equal to the value appearing at the right of the detent mark. As the knob is rotated ccw, the clock frequency, or bandwidth, is decreased. In the full ccw position, the actual value will be at least 10:1 (and as much as 100:1) lower than the value to the right of the detent mark.

17. **VCG IN** — This connector allows external voltage control of function generator frequency. Up to 1000:1 frequency change may be obtained. A positive voltage increases frequency and a negative voltage decreases frequency. Refer to "Operation as a Voltage Controlled Generator."

SEQUENCE LENGTH

18. **$2^{10} - 1$** — Depressing this push button will provide 1,023 counts of the selected clock frequency, or bandwidth, determined by the NOISE FREQ HZ controls (15 and 16), for generation of a digital, or analog noise pattern. At the end of each sequence, the pattern is automatically repeated.

19. **$2^{15} - 1$** — Depressing this push button will provide 32,767 counts of the selected clock frequency, or bandwidth, determined by the NOISE FREQ HZ controls (15 and 16), for generation of a digital, or analog noise pattern. At the end of each sequence, the pattern is automatically repeated.

20. **$2^{20} - 1$** — Depressing this push button will provide 1,048,575 counts of the selected clock frequency, or bandwidth, determined by the NOISE FREQ HZ controls (15 and 16), for generation of a digital, or analog noise pattern. At the end of each sequence, the pattern is automatically repeated.

REAR PANEL

21. **DC OFFSET** — This control adjusts the ±5 V base line above or below ground (±2.5 V offset into 50Ω load). The OFF position gives normal vertical symmetry. Peak amplitude is limited by the dynamic range of the amplifier output.

22. **FUNCTION SYNC** — This connector provides a synchronizing signal output at the same frequency of the main generator; that is, at the same frequency as the sine, triangle or square wave. The amplitude is greater than 1 V peak to peak square wave into open circuit at 600Ω output impedance.

23. **NOISE SYNC** — This connector provides a synchronizing output signal for monitoring the digital or analog noise. A sync signal is generated at the beginning of each repetitive cycle for the selected sequence length of digital or analog noise.

24. **NOISE CLOCK** — This connector provides an external output of the basic clock frequency used to generate the digital sequence and analog noise.

Figure 2-2. Operating Controls, Rear Panel

OPERATION

No preparation for operation is required beyond completion of the initial installation previously stated in this section. It is recommended that a one-half hour warm-up period be allowed for the associated equipment to reach a stabilized operating temperature and for the Model 132 to attain stated accuracies.

Operation as a Function Generator

1. Terminate 50Ω OUT connector with 50Ω ±1%, 2 watt termination.
2. Select the desired waveform by setting function selector to ∿ , ⩘ , or ⊓ .
3. Set frequency dial and FREQ HZ range multiplier for desired output frequency.
4. Depress MODE — FUNC push button.
5. Select output signal amplitude by setting OUTPUT ATTEN (dB) control to appropriate attenuation position and fine adjusting signal to desired amplitude with OUTPUT VERNIER (dB) control.
6. A positive or negative dc offset may be applied to the waveform by setting the DC OFFSET (Rear Panel) to the desired level. The peak signal value plus the offset cannot exceed ±5.0 V into 50 ohms.

Operation as a Voltage Controlled Generator

The VCG input connector can be used to externally control the frequency of the generator. If a positive voltage is applied to the VCG input terminal, the frequency will increase from the dial setting. A negative voltage will cause the frequency to decrease from the dial setting. The VCG range of the Model 132 is 1000:1.

1. Terminate 50Ω OUT connector with 50 ohm ±1%, 2 watt termination.
2. Select the desired waveform by setting function selector to ∿ , ⩘ , or ⊓ .
3. Set FREQ HZ selector to desired multiplier.
4. Connect external voltage source (dc programming or wideband ac signal) to VCG IN connector.

NOTE

VCG input requires 0 to ±5 volts for operation over full-scale range, but can withstand many times maximum input.

5. Set frequency dial as follows:
   a. For frequency modulation with ac input, set dial for center frequency.

b. For increasing frequency sweep with positive dc input, set dial to lower frequency limit.
c. For decreasing frequency sweep with negative dc input, set dial to upper frequency limit.

6. To sweep the audio range from 20 Hz to 20 kHz, set the controls to 20 Hz as follows:
   a. Set the main dial to 0.02.
   b. Set the frequency vernier to the full ccw position.
   c. Introduce a 0 to +5 V ramp into the VCG input connector.

The maximum frequency which may be obtained, when using the VCG input, is the range multiplier times the value at the top of the dial (2.0). The minimum frequency is the range multiplier times the value at the bottom of the dial (0.002 — frequency vernier must be in ccw position). Verify this using the nomograph in Figure 2-3.

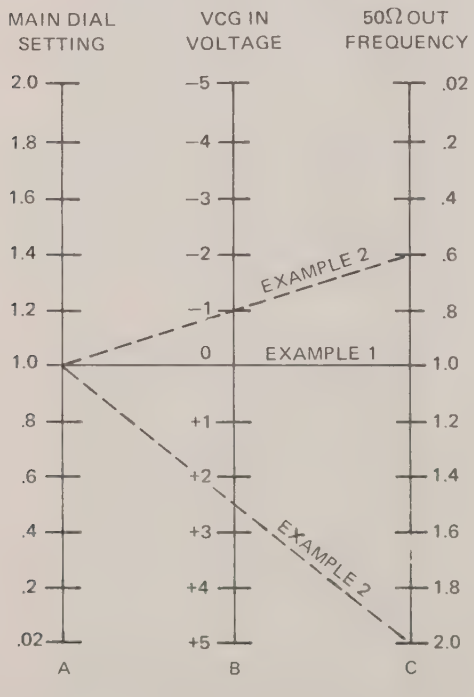


Figure 2-3 - VCG Voltage-to-Frequency Nomograph

In example 1, the dial is set at 1.0 and 0 voltage is applied to the VCG input. Extend a straight line from 1.0 (dial setting) through 0 voltage (VCG voltage) and obtain a dial frequency of 1.0. For the total output frequency, multiply the range by 1 with the same dial setting. Example 2 shows the results of using a ramp from −1 volt to +2.5 volts for the VCG voltage. This results in a swept output from 0.6 to 2.0 on the dial. Remember to multiply the dial times the range.

Operation as a Calibrated Signal-to-Noise Source

1. Select the desired signal waveform by setting function selector to ∿ , ⩘ , or ⎍ .
2. Set frequency dial and FREQ HZ range multiplier for desired signal output frequency.
3. Depress MODE — S/N push button.
4. Select noise bandwidth by setting NOISE FREQ HZ control to desired range and fine adjusting bandwidth by turning the noise frequency Hz vernier control.
5. Select desired SEQUENCE LENGTH by depressing appropriate push button.
6. Select signal-to-noise ratio by setting S/N — N/S (dB) control to appropriate attenuation position and fine adjusting attenuation to desired value with S/N — N/S vernier control.
7. Select total output amplitude by setting OUTPUT ATTEN (dB) control to appropriate attenuation position and fine adjusting signal to desired amplitude with OUTPUT VERNIER (dB) control.

Operation as a Calibrated Noise-to-Signal Source

1. Select the desired signal waveform by setting function selector to ∿ , ⩘ , or ⎍ .
2. Set frequency dial and FREQ HZ range multiplier for desired signal output frequency.
3. Depress MODE — N/S push button.
4. Select noise bandwidth by setting NOISE FREQ HZ control to desired range and fine adjusting bandwidth by turning the noise frequency Hz vernier control.
5. Select desired SEQUENCE LENGTH by depressing appropriate push button.
6. Select noise-to-signal ratio by setting S/N — N/S (dB) control to appropriate attenuation position and fine adjusting attenuation to desired value with S/N — N/S vernier control.
7. Select total output amplitude by setting OUTPUT ATTEN (dB) control to appropriate attenuation position and fine adjusting signal to de-

sired amplitude with OUTPUT VERNIER (dB) control.

Operation as a Random FM Source

Before using the generator as a random FM source, please note the following.

The frequency of the generator is being varied or modulated by a changing voltage in the same way as described in "Operation as a Voltage Controlled Generator." However, instead of using a dc ramp, or ac signal, a random analog voltage is used. When the FM push button is depressed, the analog noise is injected internally into the VCG circuit; therefore, the modulation is created by random noise. The S/N — N/S (dB) knob controls the maximum amount of frequency deviation, since it controls the amplitude of the noise. Bandwidth of the FM signal is controlled by the NOISE FREQ HZ control. Using the generator in the FM mode may be accomplished as follows:

1. Select the desired signal waveform by setting function selector to ∿ , ⩘ , or ⊓ .
2. Set frequency dial and FREQ HZ range multiplier for desired center output frequency.
3. Depress MODE — FUNC and FM push buttons.
4. Select the bandwidth by setting NOISE FREQ HZ control to desired range and fine adjusting frequency by turning the noise frequency Hz vernier control.
5. Select desired SEQUENCE LENGTH by depressing appropriate push button.
6. Select signal frequency deviation by setting S/N — N/S (dB) control to appropriate attenuation position and fine adjusting attenuation to desired deviation with S/N — N/S vernier control.
7. Select output signal amplitude by setting OUTPUT ATTEN (dB) control to appropriate attenuation position and fine adjusting signal to desired amplitude with OUTPUT VERNIER (dB) control.

Operation as a Digital or Analog Noise Source

1. Set function selector to digital or analog noise position.
2. Depress MODE — FUNC push button.
3. Select clock frequency for digital or bandwidth for analog noise by setting NOISE FREQ HZ control to desired range and fine adjusting frequency by turning the noise frequency Hz vernier control.
4. Select desired SEQUENCE LENGTH by depressing appropriate push button.
5. Select noise amplitude by setting OUTPUT ATTEN (dB) control to appropriate attenuation position and fine adjusting noise to desired amplitude with OUTPUT VERNIER (dB) control.

Connect Signal and Chassis Grounds

The instrument is shipped from the factory with the signal ground floating above chassis ground, unless otherwise specified. A common signal/chassis ground can be obtained as follows:

1. Remove power cord.
2. Loosen two captive thumb screws on rear panel and remove panel.
3. Solder a jumper wire between the ground lugs (green wires) of the SYNC OUT connector and the power connector (Figure 2-4).

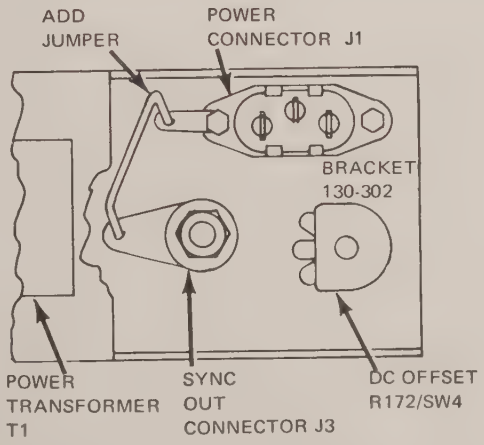


Figure 2-2. Common Ground Connection Diagram

Converting Output Impedance to 600 Ohms

Unless otherwise specified, this instrument was shipped with 50 ohm output impedance, but can be converted to 600 ohm output if needed. Place a 550Ω resistor in series with the wire leading from the center tap of the 50Ω OUT BNC and the attenuator control.

Converting to 230-Volt Line Power

Instruments are shipped from the factory with the power transformer connected for 115-volt line power, unless ordered for 230-volt use. Converting a 115-volt unit for 230-volt operation is a simple matter.

1. Remove power cord.
2. Loosen two captive thumb screws on rear panel and remove panel.
3. The conversion switch is located on the chassis. Use a thin-bladed screwdriver to move the 115-230 switch to the 230 position.
4. Replace 1/4-ampere fuse with a 1/8-ampere fuse of the same type.

SECTION 3
CIRCUIT DESCRIPTION

GENERAL DESCRIPTION

Refer to the block diagram of the Model 132 VCG/ Noise Generator, Figure 3-1.

Basically, a square wave is applied to the input of an integrator composed of a wide-band differential dc amplifier, integrating resistor and capacitor. Output of the integrator is fed into the hysteresis switch. The hysteresis and output switches function like a Schmitt trigger with the limit points set at the waveform extremes, firing when the triangle wave reaches +1.25 volts and −1.25 volts. When firing occurs, the hysteresis and output switches are set, reversing the square wave fed into the integrator. Reversal of the square wave causes the triangle wave to reverse direc-

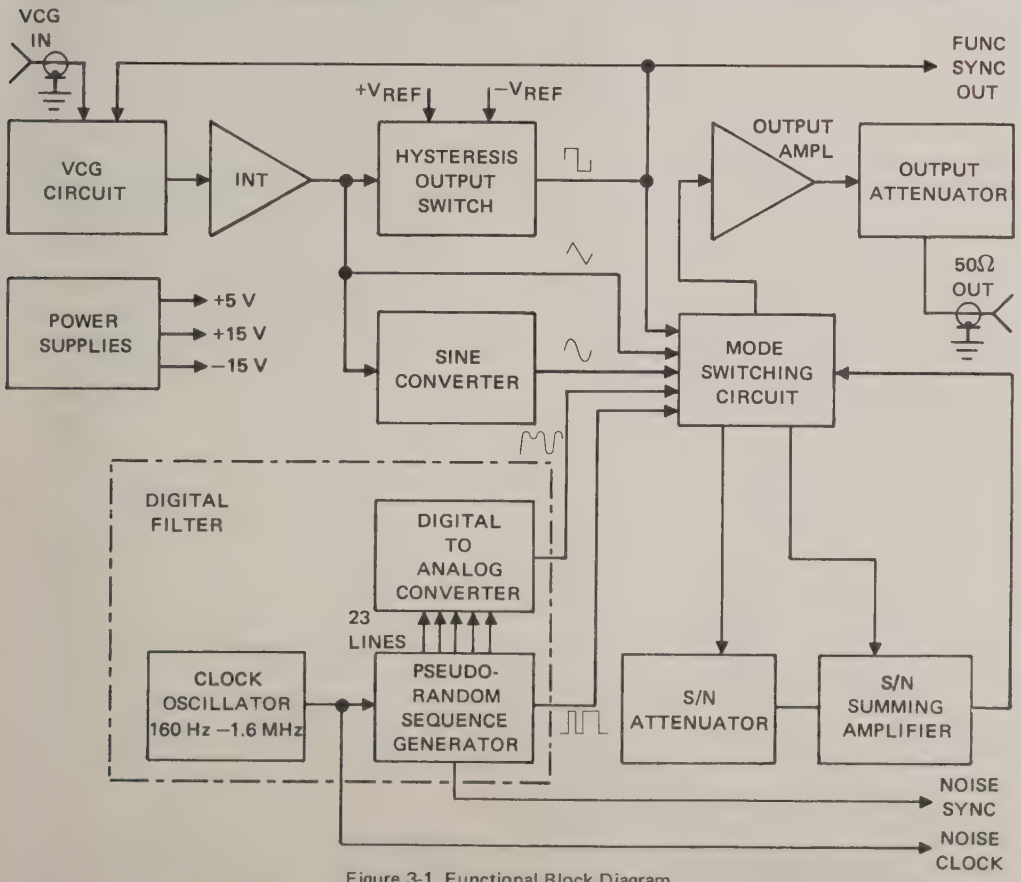


Figure 3-1. Functional Block Diagram

tion. The result is simultaneous generation of a square wave and triangle wave of the same frequency with the positive half cycle of the square wave coincident with the negative slope of the triangle wave.

The magnitude of the capacitor across the integrator and amplitude of the current into the integrator determine the frequency of oscillation. Capacitance across the integrator is changed by rotating the frequency Hz selector. Amplitude of the current into the integrator is determined by four parameters which are summed in the VCG circuit: (1) hysteresis switch output, (2) the frequency dial voltage, (3) the frequency vernier voltage, (4) the VCG analog voltage input and (5) the analog noise when in the FM mode.

The sine wave is produced by feeding the triangle wave into a shaping network composed of resistors and diodes. As the triangle wave voltage passes through zero, loading of the triangle wave is minimal and thus the slope is maximum. As the triangle voltage increases, diodes with current limiting resistors conduct and successively cause the slope of the output to be reduced.

Since the diode break points are mathematically computed and fitted to the true sine shape, the resultant waveform resembles a pure sine wave. Using a complementary pair of diodes on each break point, the circuitry is completely symmetrical about ground. The sine wave, produced by shaping, is considerably less in amplitude than the triangle wave input and is thus amplified to be equal to the triangle wave.

Either square, triangle, or sine waveforms can be selected as a signal source. The noise source is derived from a digital filter. A clock oscillator of 160 Hz to 1.6 MHz range functions as a trigger source for the digital pseudo-random sequence generator (PRSG). Output of the PRSG is a random binary signal that can function as digital noise. The number of bits in each sequence can be selected by the SEQUENCE LENGTH controls. Parallel data is fed from the PRSG to the digital-to-analog converter where the information is summed and filtered to provide a random analog noise signal.

The selected sine, triangle, square, analog noise, or digital noise signal is routed to the mode control circuitry where one of the following modes of operation is selected: Function (FUNC); frequency modulation (FM); signal-to-noise (S/N); or noise-to-signal (N/S). In the signal-to-noise and noise-to-signal modes, one signal is fed to the S/N attenuator and then mixed with the other signal in the S/N summing amplifier in a known dB ratio selected by the S/N attenuator. Output of the mode switching circuit is coupled to the output amplifier. From the output amplifier the signal is fed to the precision output attenuator and finally to a 50Ω output connector.

All circuits, except for the hysteresis switch, output amplifier, and PRSG, operate from ±15 volt supplies. The hysteresis switch and power amplifier require ±6 volts and ±22 volts, respectively. Operation of the PRSG requires a +5 V supply.

SECTION 4
MAINTENANCE

INTRODUCTION

This section provides instructions for testing, calibrating, troubleshooting, and repairing the Model 132. The instructions are concise and for the experienced electronics technician or field engineer. Wavetek maintains a factory-repair department for those customers not possessing the necessary personnel or test equipment to maintain the instrument. If an instrument is returned to the factory for calibration or repair, a detailed description of the specific problem should be attached to facilitate the turn around time. Test point and adjustment locations are illustrated in Section 5.

RECOMMENDED TEST EQUIPMENT

Table 4-1 contains a list of recommended test equipment. Any test equipment having equivalent accuracies may be substituted for those listed.

Table 4-1. TEST EQUIPMENT

Name	Required Characteristics
Oscilloscope	To 30 MHz
Plug-in	Dual Channel
Plug-in	Peak mV measuring capability
Distortion Analyzer	To 600 kHz
Spectrum Analyzer	To 50 MHz
Display	
IF Section	
RF Section	
Voltmeter	Millivolt dc measurement (10 millivolt resolution)
Counter	To 10 MHz
Scope Probe	X1 Attenuation

CHECKOUT AND CALIBRATION

The following paragraphs provide complete sequential calibration procedures for the Model 132. Instrument checkout procedures are indicated by a check mark (✓) following the procedure title. A quick checkout of the instrument can be performed by comparing the indicated parameters with the tolerances given in the Specifications of Section 1.

NOTE

The entire calibration procedure must be read first to determine initial control settings and test equipment connections before attempting checkout.

Preliminary Procedures

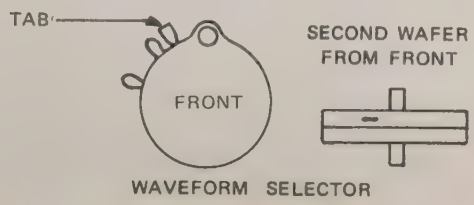
1. Set FREQ HZ selector to X1K position.
2. Depress MODE — FUNC push button.
3. Set OUTPUT ATTEN (dB) selector to 0 position.
4. Allow one-half hour for warm-up.

Power Supply Regulation

1. Connect voltmeter between TP1 (common) and TP2 (+) on main board. Adjust R104 for +15 Vdc ±100 mV.
2. Connect voltmeter between TP1 (common) and TP3 (—). Since the negative supply is referenced to the +15 V supply, the voltmeter should indicate −15 Vdc ±100 mV.
3. Connect voltmeter between +5 V and location DG on analog board. Verify that voltage is +4.75 to +5.25 volts.

Square Wave Amplitude Symmetry

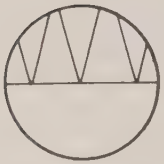
1. Set function selector to ⊓⊔ .
2. Connect oscilloscope, with peak mV plug-in, to tab of switch SW3B, as illustrated below.



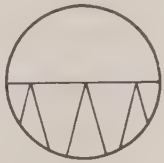
3. Using a comparator, set the positive peak to the center of the scope. Switch the comparator to the negative peak and adjust R121 so that the negative peak equals the positive peak.

Triangle Amplitude

1. Set frequency dial for 2.0 (X1K range) and function selector to ⩘ .
2. Connect oscilloscope, with peak mV plug-in, to tab of switch SW3B, as illustrated under "Square Wave Amplitude Symmetry."
3. Adjust R56 on main board for positive peak at +1.25 volts ±5 mV (see sketch).
4. Adjust R59 for negative peak at −1.25 V ±5 mV.



Negative Peak



Positive Peak

Output Amplifier √

1. Connect oscilloscope to 50Ω OUT connector with 50Ω terminator loaded at oscilloscope (⎍ function).
2. Set FREQ HZ selector for X1K (FREQ VERNIER fully cw) and frequency dial at 2.0.
3. Turn OUTPUT VERNIER (dB) fully ccw.
4. Adjust R150 for amplitude symmetry about ground.
5. Set FREQ HZ selector for X1M (2.0 dial setting).
6. Turn OUTPUT VERNIER (dB) fully cw.
7. Adjust C64 to provide a flat square wave with 100 nanosecond rise time.

First VCG Null √

1. Connect oscilloscope to 50Ω OUT connector.
2. Set FREQ HZ selector to X1K. Set frequency dial to 0.02 and turn FREQ VERNIER to CAL position.
3. Short and open VCG IN to signal ground (outside of BNC connector) while monitoring output frequency variation. Adjust R11 for minimum frequency change using X20 horizontal magnification on oscilloscope.

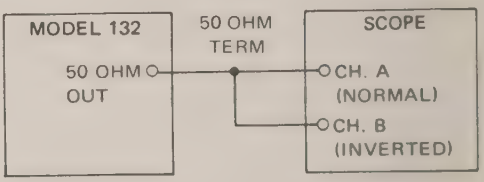
Time Symmetry √

1. Connect unit and oscilloscope, with dual channel plug-in set for alternate display, as shown in Figure 4-1.
2. Set FREQ HZ selector for X100K with FREQ VERNIER in CAL position (⎍ function).
3. Set frequency dial to 0.02 to provide 2 kHz display on oscilloscope.
4. Adjust R28 for time symmetry with frequency dial set to 0.02.
5. Turn FREQ VERNIER fully ccw and adjust R22 for time symmetry.

NOTE

Interaction occurs between R28 and R22. Repeat steps 4 and 5 until 1% symmetry accuracy is met. (On oscilloscope 1% — 1 cm at 0.1 µsec with X10 horizontal magnification.)

6. Check for waveform time symmetry at the 0.2 and 2 frequency dial settings.
7. Check to assure FREQ HZ selector is set to X100K position with FREQ VERNIER turned fully ccw.
8. Turn frequency dial fully cw.
9. Check frequency ratio from top range setting to 1/1000 of range (not dial setting).
10. Adjust R8, if necessary, for slightly greater than 1000:1 ratio.



Trigger: Internal

Time Base: 50 microseconds/cm for 1/100 of 200 kHz

Display: Alternate

500 microseconds/cm for 1/1000 of 200 kHz

Figure 4-1.
Time Symmetry Measurement for Test Setup

Frequency Calibration ✓

1. Connect counter to 50Ω OUT connector.
2. Set FREQ HZ selector to X10K and FREQ VERNIER fully cw.
3. Align 2.0 dial mark with the dial indicator index and alternately switch from X10K to X1K range while adjusting R4 for a balanced error between the two positions of less than 2%.
4. Set FREQ HZ selector to X100K and dial at 2.0.
5. Adjust C16 to obtain 200.0 kHz on counter display.
6. Set FREQ HZ selector to X1M. Adjust C12 to obtain 2.00 MHz on counter display.
7. Dial alignment — No alignment is necessary if the dial is the push-on type. If it has a set screw, consult the factory for CAL procedure.

Sine Distortion, Amplitude, and Balance ✓

1. Set FREQ HZ selector for X1K, FREQ VERNIER fully cw, function selector to ∿, and frequency dial at 2.0.
2. Connect oscilloscope, with peak mV plug-in, to orange wire on function switch.
3. Adjust R133 to obtain 2.5 V p-p ±25 mV output.
4. Adjust R128 to balance output.
5. Connect the unit, distortion analyzer, and oscilloscope as shown in Figure 4-2.
6. Adjust R126 and R127 for less than 0.5% sine distortion (see photo).
7. Set FREQ HZ selector to X10K.

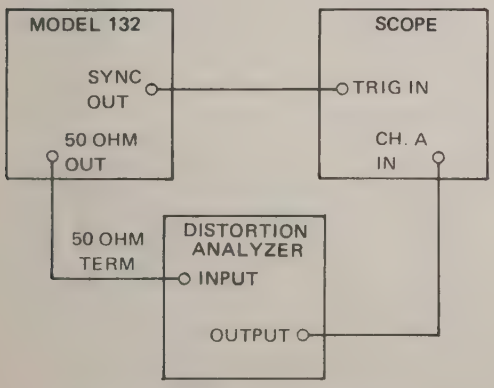
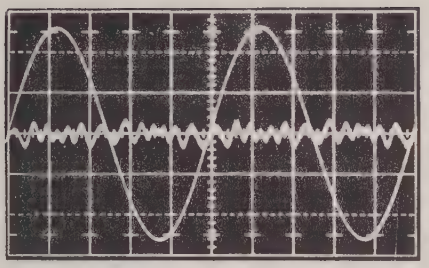


Figure 4-2. Distortion Analysis Test Setup



8. Repeat step 6 for steps 1 and 7 to obtain less than 0.5% distortion at both X1K and X10K ranges.
9. Repeat steps 2, 3 and 4.
10. Connect spectrum analyzer and check sine distortion at 2 MHz.

Clock Frequency Calibration ✓

1. Remove power from unit.
2. Remove two Phillips head screws from logic board (one from left side of board, one from right side).
3. Remove two 2½" standoff screws at rear of logic board.
4. Lift front edge of logic board until board is standing upright. (Right rear edge of logic board will now be resting on sine module.
5. Place at least ¼" of styrofoam, or other suitable insulating material, between BNC connectors and main board. (BNC connectors are located near left rear edge of logic board.)

CAUTION

Failure to adequately insulate BNC connectors from main board may result in electrical damage.

6. Apply power to unit.
7. Set function selector to ⎍⎍ position.
8. Set NOISE FREQ HZ selector to 1.6M position and NOISE FREQ HZ vernier fully cw.
9. Connect counter to NOISE CLOCK connector (rear panel).
10. Adjust C6 on digital board for 1.6 MHz (ideally 1.62 MHz).
11. Turn NOISE FREQ HZ vernier fully ccw and adjust R2 for 150 kHz ±1 kHz.

Digital Noise Amplitude Symmetry ✓

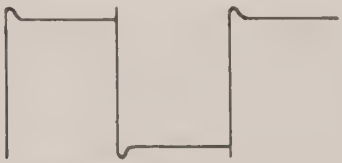
1. Set function selector to ⎍⎍⎍, NOISE FREQ HZ selector to 160 kHz, and depress SEQUENCE LENGTH — $2^{15} - 1$ push button.
2. Connect oscilloscope, with peak mV plug-in, to location DN on digital board.
3. Adjust R36, using comparator, to provide a positive peak of +1.25 V ±10 mV.
4. Adjust R39, using comparator, to provide a negative peak of −1.25 V ±10 mV.

Analog Noise Amplitude Symmetry

1. Connect BNC cable to NOISE SYNC connector (rear panel) and sync connector on oscilloscope.
2. Depress SEQUENCE LENGTH — $2^{15} - 1$ push button.
3. Connect oscilloscope to location AN on digital board.
4. Adjust R22 (gain) and R23 (balance) to provide a 2.5 V p-p signal centered about ground.

S/N Frequency Compensation ✓

1. Set function selector to ⎍.
2. Depress MODE — S/N push button.
3. Set frequency dial to 1.0 and FREQ HZ selector to X100K (100 kHz).
4. Set S/N — N/S (dB) selector to +50 position and turn vernier to +9 position to provide approximately +59 dB.
5. Turn OUTPUT VERNIER (dB) full cw.
6. Connect oscilloscope to 50Ω OUT connector with 50Ω terminator (⎍ function).
7. Adjust C5 on analog board for a slightly peaked square wave response, as illustrated below.



8. Remove power from unit.
9. Remove material insulating BNC connectors from main board.
10. Lower logic board and align holes in side of board with screw holes.
11. Install two side screws to secure logic board.
12. Install both 2½" standoff screws at rear of logic board.
13. Install cover on unit.

TROUBLESHOOTING

Basic Techniques

Troubleshooting the Model 132 requires no special technique. Listed below are a few reminders of basic electronics fault isolation.

1. Check control settings carefully. Many times an incorrect control setting, or a knob that has loosened on its shaft, will cause a false indication of a malfunction.
2. Check associated equipment connections. Make sure that all connections are securely connected to the correct connector.
3. Perform the checkout procedure. Many out-of-specification indications can be corrected by performing specific calibration procedures.
4. Visually check the interior of the instrument. Look for such indications as broken wires, charred components, loose leads, etc.

Troubleshooting Chart

Table 4-2 provides a list of possible malfunction symptoms, their probable causes, and the prescribed remedies. Also listed in this table are the test points at which measurements are to be made and the parameter tolerances at these points. To use the troubleshooting chart, locate the symptom listed in Column 1 and follow the corresponding procedures. Localize the fault to a specific stage by checking the parameters given for the major test points. Then check the dc operating voltages at the pins of solid-state devices. Check associated passive elements with a high input impedance ohmmeter (power off) before replacing a suspected semiconductor element.

Troubleshooting Hints

The interactive nature of a closed loop presents a somewhat special problem when approached from a troubleshooting standpoint. The simplest way to reduce problem complexity is to open the loop, thereby removing the interaction. The basic units of the loop can then be tested individually. The following step-by-step procedure describes how this is done. (The generator loop is all contained on the main board.) Consult the next paragraph for removal of cover and panels.

1. Set instrument controls for 20 V p-p, 2 kHz sine-wave output.

Table 4-2. TROUBLESHOOTING CHART

Symptom	Probable Cause	Corrective Procedures
No outputs at 50Ω OUT connector	Blown Fuse	Replace F1. a. 1/4A — 115 Vac b. 1/8A — 220 Vac
	Power Supply	Check TP1/TP2 for +15 V; +5 V/DG for +5 V; TP1/TP3 for −15 V; TP1/TP5 for +6 V; TP1/TP6 for −6 V. Troubleshoot associated regulator.
	Output Amplifier	Check at PH for waveform as selected by position of waveform switch. a. If waveform is present, troubleshoot output amplifier. b. If no waveforms are present, refer to Troubleshooting Hints.
	50Ω Attenuator	Check to see that output is present at switch. If it is, the switch is defective.
No sine wave output	Sine Amplifier	Check for 260 mV p-p sine wave at pin 4 of IC8. a. If present, check IC8 circuit. *NOTE: Triangle wave must be present at pin 2 of A1 to obtain sine wave output.* b. If not present, check A1 circuit.
No triangle, sine, or square wave	Generator Loop	Refer to Troubleshooting Hints.
No	Power Supply	Check for correct voltages.
	Clock Oscillator	Check Q1 — Q8 circuit.
	Faulty IC	Refer to Troubleshooting Hints.
	Shaping Amplifier	Check Q12 — Q14 circuit.
No	No	(See above.)
	Faulty Summing Amplifier	Check Q9 — Q11 circuit.
	Faulty Low Pass Filter	Check IC1 circuit.
No output in S/N or N/S	Faulty Summing Amplifier	Check IC2 circuit.
No noise in S/N mode	Faulty Attenuator	Check Test Point AW for noise. If not present and controllable by S/N — N/S (dB) switch, the switch is defective. If present, check IC1 and IC2 circuits.

Table 4-2. TROUBLESHOOTING CHART (Continued)

Symptom	Probable Cause	Corrective Procedures
All waveforms low in amplitude	Power Amplifier	a. Check front panel amplitude control. b. Perform balance adjustment for power amplifier.
	Power Supply	Check for correct voltages.
All waveforms low in amplitude	Power Amplifier	a. Check front panel amplitude control. b. Perform balance adjustment for power amplifier.
	Power Supply	Check for correct voltages.
Frequency out of tolerance	Power Supply	Check for correct power supply voltage as stated above.
	Maladjustment	Perform calibration procedure.
Sine wave not in spec	Maladjustment	Perform sine distortion, amplitude, and balance adjustments.
	Sine Converter	Check for 260 mV p-p sine wave at pin 4 of IC8. a. If normal, check sine amplifier IC8. b. If normal, check A1 circuit.
Time symmetry of waveforms not correct	Maladjustment	Perform time symmetry and frequency adjustments.

2. Check at coaxial-wire lug of function selector switch for a 2.5 V p-p square wave. If normal, check output amplifier (Q34 – Q40).
3. Unsolder and lift the end of R51 (TP7). This is the output of the integrator and input to the hysteresis switch. The generator loop has now been opened.
4. Inject a 2.5 V p-p triangle waveform into the hysteresis switch input lead (TP7).
5. Check at the coaxial-wire lug of the function selector switch for a 2.5 V p-p square wave at the injected frequency.
   a. If present, hysteresis and output switches are functioning normally. Proceed to Step 6.
   b. If abnormal, check Q6 – Q16 stages.
6. Vary frequency dial from ccw to cw while observing TP11 with a scope. Voltage at this point should remain at 0 volts throughout dial rotation. If a voltage variation is observed, check IC1 stage.
7. Vary frequency dial from ccw to cw while observing TP4. Voltage reading should vary from 0 to approximately –6 volts. If voltage does not vary, check IC2 stage and IC1 stage.
8. Vary frequency dial from ccw to cw while observing TP9. Voltage reading should remain at 0 volts. If voltage varies, check IC3 stage.
9. Vary frequency dial from ccw to cw while observing TP10. Voltage should vary from 0 V to approximately +6 V. If voltage does not vary, check IC2 stage and IC3 stage.
10. Vary frequency dial from ccw to cw while observing TP8. Voltage reading should remain at 0 volts. If voltage varies, check IC4 and IC5 stages.
11. Reinstall R51.

DIGITAL BOARD

If a fault in the logic circuit of the digital filter is sus-

pected, the following procedure may be used to isolate the bad IC.

1. Set clock frequency to 1.0 MHz.
2. Verify that a clock pulse appears at pins 9 and 12 of IC2 through IC13.
3. Short circuit test point RT to DG. (This opens the digital feedback loop.)
4. Check for logic "zero" at pins 3 and 5 of IC2 through IC13.
5. Check for logic "one" at pins 2 and 6 of IC2 through IC13.
6. Check logic states of all gates using the known states of the register.

REMOVAL OF DUST COVERS AND PANELS

1. To gain access for calibration or maintenance, proceed as follows:
   a. Remove power cord.
   b. Loosen the two knurled captive screws on the rear panel.
   c. Pull off the rear panel.
   d. Remove the cover.
2. To gain access to the digital board, proceed as follows:
   a. Remove the four screws holding the digital board.
   b. Rotate the board upward using the rear of the instrument as a pivot point.
3. To gain access to the analog board and/or the main board, proceed as follows:
   a. Remove digital board.
   b. Remove one screw and shoulder washer holding 5 V regulator to side plate.
   c. Remove all knobs below the push button switches.
   d. Remove two nuts, washers, and insulators holding the switch assembly to the front panel.
   e. Remove two screws holding rear bracket to chassis.
   f. Disconnect all AMP pin connections between main board and analog board.
   g. Unsolder two wires from 50Ω OUT connector.
   h. Unsolder coaxial cable from main board to 50Ω attenuator.
   i. Remove four screws holding analog board to side plates.
   j. Carefully lift rear of analog board to clear the sine converter and slide analog board, rear bracket and digital board away from the front panel.
4. To gain access to any part mounted on upper rear bracket, proceed as follows:
   a. Remove digital board.
   b. Remove two screws holding lower and upper rear brackets to chassis.
   c. Remove one heat sink mounting screw.
   d. Remove bottom transformer mounting block screw.
   e. Remove the two screws, lock washers and hex nuts holding two wafers of FREQ HZ switch to bracket assembly.
   f. Remove two screws holding bracket assembly to main board.
   g. Carefully pull bracket assembly to rear to obtain working room. Enough slack is available in the wiring for all normal operations.
5. To remove front panel, proceed as follows:
   a. Remove rear panel and dust cover as previously described.
   b. Remove all knobs, except frequency dial.
   c. Unsolder BNC connections.
   d. Tag and unsolder frequency-dial potentiometer leads.
   e. Pull light bulb from indicator lens.
   f. Remove four front panel retaining screws.
   g. Remove two hex nuts, lock washers, and shoulder washers holding switch bracket assembly to front panel.
   h. Carefully pull off front panel with frequency dial/potentiometer still attached.

REPLACEMENT OF SWITCH WAFERS AND POTENTIOMETERS

1. To replace FREQ HZ switch wafer C or D or the FREQ VERNIER potentiometer, proceed as follows:
   a. Remove rear panel and dust cover as previously described.
   b. Separate bracket assembly from chassis as previously described.
   c. Tag and unsolder leads to part being replaced.
   d. Pull defective part off shaft and repair or replace with recommended replacement part.
2. To replace FREQ HZ switch wafer A or B, proceed as follows:
   a. Remove rear panel and dust cover as previously described.
   b. Remove front panel as previously described.

c. Tag and unsolder wires to switch wafers A and B.
d. Remove digital and analog boards as previously described.
e. Unsolder wafer B PC-tabs from printed circuit boards.
f. Lift switch shaft slightly to free PC-tabs, rotate switch shaft so wafers clear board parts, and pull shaft end free of rear-mounted wafers C and D.
g. Repair or replace defective part.

3. To repair or replace function selector wafers or OUTPUT VERNIER (dB) potentiometer, proceed as follows:
a. Remove rear panel and dust cover as previously described.
b. Tag and unsolder wires to defective part.
c. Remove digital and analog boards as previously described.
d. Unsolder potentiometer PC-tabs, lift shaft slightly to free tabs, rotate switch shaft so wafers clear board parts, and pull switch/potentiometer assembly out of front panel hole.
e. Repair or replace defective part.

REPLACEMENT OF SINE CONVERTER

1. Remove rear panel and dust cover as previously described.
2. Remove digital board as previously described.
3. Unsolder the five pins of sine converter A1 from top of the printed circuit board, using a solder syringe.
4. Lift assembly from bottom of the board; a thin pencil-type soldering iron can be used, if necessary, to apply temporary heat during removal.
5. Replace sine converter.

SECTION 5
DATA PACKAGE

INTRODUCTION

This section contains data packages for the Model 132. Each data package is a quick-access document, containing maintenance data arranged for convenient viewing of the schematic diagram and all supporting data. Each data package includes a parts-location illustration, a replaceable parts list, voltage/waveform data, and a schematic diagram. Voltage and waveform data are provided on the diagrams at indicated test points as an aid to troubleshooting.

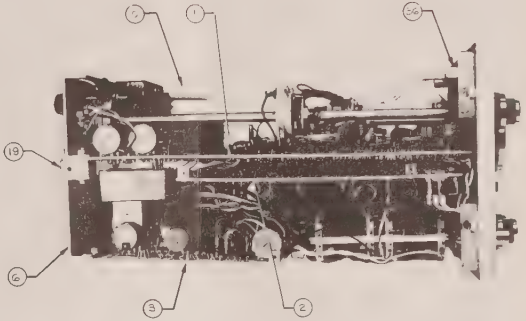
RECOMMENDED SPARE PARTS LIST

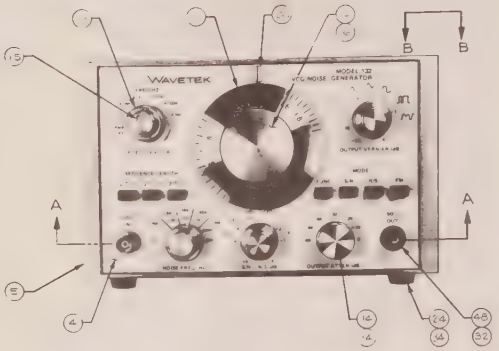
Information is provided to maintain the instrument on a component level. Price and delivery information should be obtained from the Wavetek representative in your area or directly from the factory.

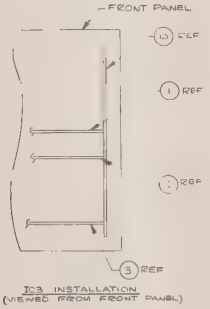
DESCRIPTION	MANUFACTURER	PART NO.	QTY
DIODE	FAIRCHILD	FD6666	2
DIODE	SEMTECH	SCE–1	2
DIODE	WAVETEK	130–506	1
FUSE 1/8A 250 V	BUSSMAN	MDL 1/8	1
FUSE 1/4A 115 V	LITTELFUSE	313–250	
IC	RCA	*CA3039 (–18)	1
IC	RCA	*CA3030 (–15)	1
IC	RCA	*CA3030 (–16)	1
IC	RCA	*CA3036 (–17)	1
IC	SIGNETICS	SG310	1
IC	NATIONAL SEMICONDUCTOR	NS7400	1
IC	NATIONAL SEMICONDUCTOR	NS7402	1
IC	NATIONAL SEMICONDUCTOR	NS7404	1
IC	NATIONAL SEMICONDUCTOR	NS7410	1
IC	NATIONAL SEMICONDUCTOR	NS7420	1
IC	NATIONAL SEMICONDUCTOR	NS7430	1
IC	NATIONAL SEMICONDUCTOR	NS7486	1
IC	NATIONAL SEMICONDUCTOR	NS74107	1
IC	NATIONAL SEMICONDUCTOR	LM301A	1
IC	FAIRCHILD	7805393	1
IC	FAIRCHILD	*μA709C (–14)	1
IC	FAIRCHILD	*μA709C (–13)	1
LAMP	MURA	L28/40	1
SINE MODULE	WAVETEK	130–011	1
TRANSISTOR	FAIRCHILD	2N2905A	1
TRANSISTOR	FAIRCHILD	2N2905	1
TRANSISTOR	FAIRCHILD	2N3299	1
TRANSISTOR	FAIRCHILD	2N3646	2
TRANSISTOR	FAIRCHILD	2N3638	1

DESCRIPTION	MANUFACTURER	PART NO.	QTY
TRANSISTOR	FAIRCHILD	2N3638A	1
TRANSISTOR	FAIRCHILD	2N3642	1
TRANSISTOR	FAIRCHILD	L08	1
TRANSISTOR	FAIRCHILD, MOTOROLA	2N3640	1
TRANSISTOR	FAIRCHILD	MPS L08	1
TRANSISTOR	FAIRCHILD	2N2369	1
MATCHED TRANSISTOR	FAIRCHILD	*2N2905 (–8)	2
MATCHED TRANSISTOR	FAIRCHILD	*2N3646 (–11)	2
MATCHED TRANSISTOR	FAIRCHILD	*2N3638 (–9)	2
MATCHED TRANSISTOR	MOTOROLA	*2N3640 (–10)	2
TRANSISTOR	MOTOROLA	MPS3640	1
TRANSISTOR	MOTOROLA	2N3903	1
TRANSISTOR	MOTOROLA	2N3905	1
TRANSISTOR	SPRAGUE	TD101	1
TRANSISTOR	TEXAS INST	*TIP 29	1
TRANSISTOR	TEXAS INST	*TIP 30	1

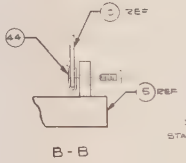
* Denotes special parts that should be ordered from Wavetek. These parts have been tested or selected by Wavetek for optimum performance.



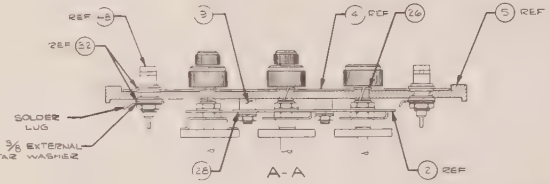




TC3 INSTALLATION
(VIEWED FROM FRONT PANEL)



B - B



A - A

1. ✱ INDICATES ITEM NOT SHOWN.

NOTES

	A	ECN #422	B 2 6 1 7	
	rev	dcn	by	date
tolerance unless otherwise specified	WAVETEK san diego			
XXX ± .010 XX ± .030				
scale 1/1	drawn B Bowman	date 23 Feb 72	appd	
material N/A	title CHASSIS ASSY			
finish N/A	model no. 132	dwg number D132 000	rev E	

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PARTS LIST

ITEM	REF DES	DESCRIPTION	MFGR	MFGR NO	QTY
1		MAIN BOARD ASSY	WAVETEK	D132-010	1
2		AMP BOARD ASSY		-017	1
3		LOGIC BOARD ASSY		-013	1
4		FRONT PANEL		B -300	1
5		FRONT CASTING		-901	1
6		MOUNTING BRACKET		C -302	1
7		REAR PANEL		B -303	1
8		REAR CASTING		-904	1
9		MOUNTING SPACER		-306	2
10		SIDE PLATE		C110-304	2
11		DIAL		A -333	1
12		DIAL KNOB		-908	1
13		COAXIAL KNOB		-909	4
14		STANDARD KNOB		-314	1
15		SMALL KNOB		L30-1549	4
16	R1	POTENTIOMETER		A131-R1A	1
17		COVER		C130-953	1
18		COVER SUPPORT		A -936	1
19		MOUNTING BLOCK		-305	2
20		DIAL INDICATOR		LN1-317	1
21		INSULATOR TIP		LN2-311	1
22		SCREW MOUNTING BRACKET		135-302	2
23	T2	TRANSFORMER		C132-300	2
24		BAIL KIT		B130-307	1
25					

PARTS LIST

ITEM	REF DES	DESCRIPTION	MFGR	MFGR NO	QTY
26		BUSHING	THOMSON	4,2FF	5
27					
28		SHOULDER WASHER	ACA	KA138-108/ 49333A-7	3
29					
30		CAPTIVE SCREW	DEUTSCH	7900 .0 8-2	3
31					
32		SHOULDER WASHER	H H SMITH	2668	8
33					
34		FASTENER	TINNERMAN	C7499-632-4	6
35					
36		RETAINER	TR APC	5305-31	1
37					
38		POWER CORD	BELDEN	17250-5	1
39					
40		FASTENER	CARR	PCN7291	2
41					
42		CHASSIS FASTENER	U.S.F.D.	13618	4
43					
44		CAPTIVE FASTENER	TINNERMAN	C 8091-832 TYPE "W"	4
45					
46		SOLDER LUG	H H SMITH	1447	4
47					
48	J2,J4, J3, J6	BNC CONNECTOR	A MG	AC 7846	4
49					
50					

REV	DESCRIPTION	DATE	APPROVED

REV	ECN	BY	DATE	APP
E	776	RAH	4-4-78	RC
D	634	RAH	1-24-78	RC
C	491	BH	11-4-77	RC
B	ECN 441	BH	9-9-77	RC
A	422	BH	4-22-77	RC

TOLERANCE UNLESS OTHERWISE SPEC
DEC ± .010
FRAC ± 1/64
ANGLES ± 30'

WAVETEK SAN DIEGO CALIFORNIA

SCALE N/A | BY GRAY | DATE 4-4-78 | APP RC

MATERIAL N/A

TITLE CHASSIS ASSY

FINISH

SIZE A | DWG NO 05-0132-010 | REV E

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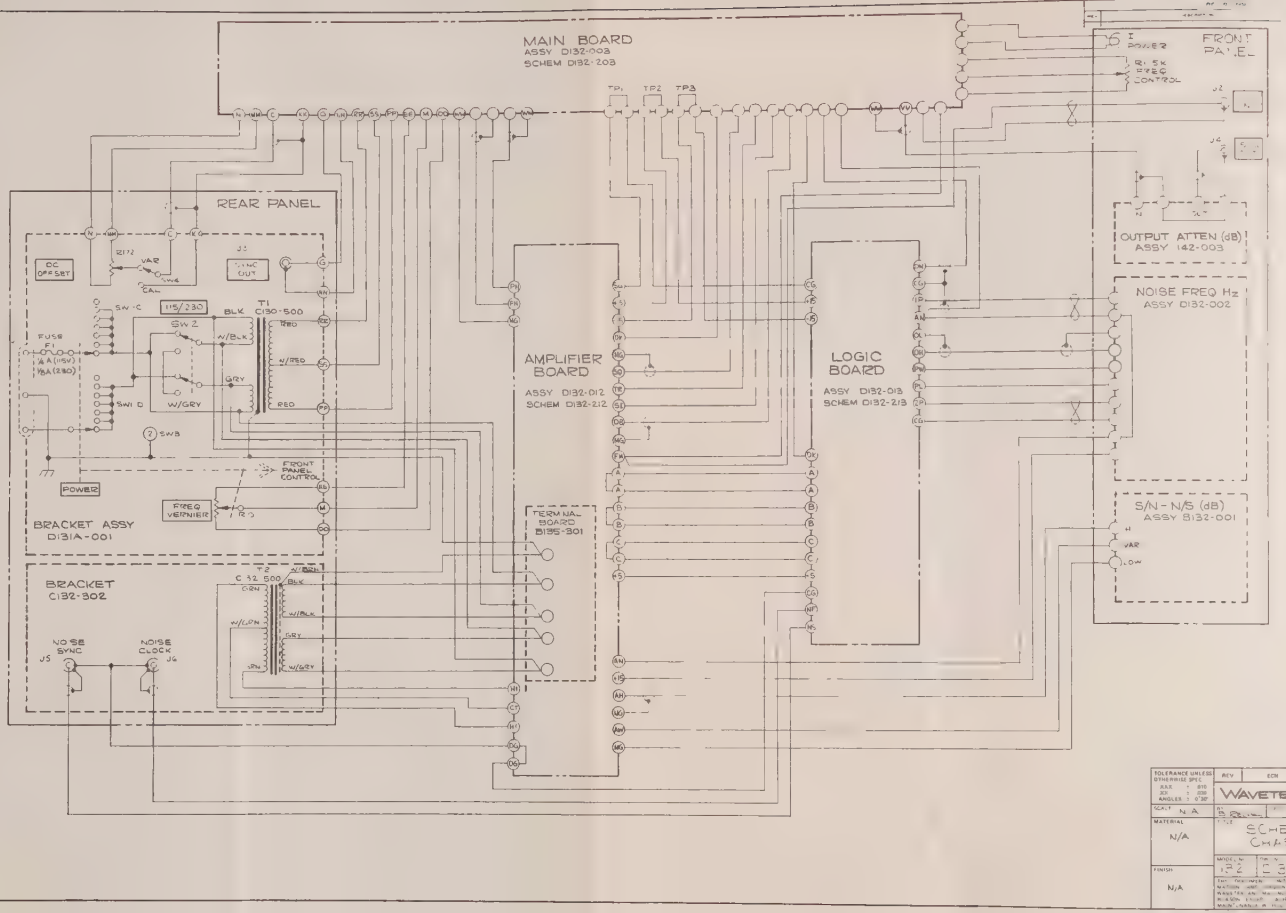


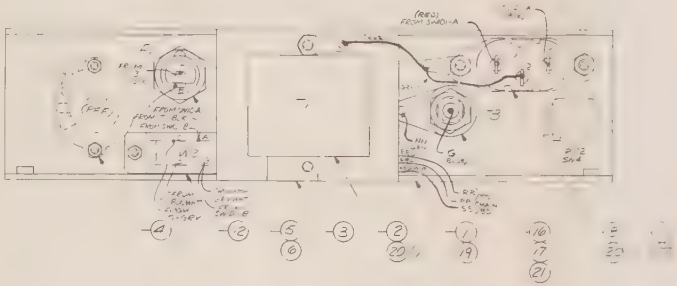
TOLERANCE UNLESS OTHERWISE SPEC	REV	ECN	BY	DATE
XXX ± .010				
XX ± .030				
ANGLES ± 1/2°				
UNIT N/A				
MATERIAL N/A				
FINISH N/A				

WAVETEK SAN DIEGO, CALIFORNIA

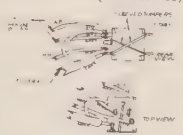
SCHEMATIC - CHASSIS

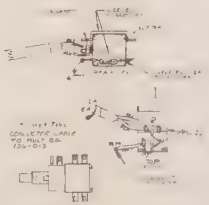
MODEL NO. 132 | DRAW NO. C132-203

ITEM	REF DES	DESCRIPTION	MFGR	MFGR NO	QTY	
		PARTS LIST	ALLTEL	6130 902	1	
2		CORD, POWER		5-3-520		
3		TRANSFORMER BRACKET		A130 306		
4		CIRCUIT BREAKER (130AA)	KH SMITH	2382	2	
5		FUSE 1/4AMP 250V	LITTELFUSE	312.250	1	FOR 115V MODEL
6		FUSE HOLDER		342012		
7		FUSE 1/8AMP 250V		MDL 118	1	FOR 230V MODEL
8		POWER RECEPTACLE	SWITCHCRAFT	EAC3-6		
9	R74	RESISTOR 10K OHM 1/2W CARBON 2.5%	ALLEN BRADLEY	RC20GF103K	1	MODEL 136 ONLY
10						
11	SW2	DPDT SLIDE SWITCH 10A/125V	A-B	7104-K032-EC-BLA		
12		115-230V SWITCH	SWITCHCRAFT	46756LE		
13				46756PDL		
14		MICA INSULATOR		A780-309		
15		HEATSINK		A130-311		
16	Q3	PNP TRANSISTOR		KCT940		
17		SHOULDER WASHER		5040	8	
18						
19		FL 21-623 4-40		4-40 x 3/8	4	
20		SOLDER LUG		#4	2	
21		SOLDER LUG		#10		
22	L2	4.4MH	TRIAD	F-30-202	1	
23						
24						
25						



USE THIS WIRING FOR 130 SERIES (NOT 136)





N	ECN 1346				
G	ECN 1233				
F	ECN 878				
E					
D					
C					
B	SUP 29				
A	ECN 293				

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES .XXX ± .010 .X ± .030	WAVETEK San Diego, Ca.		
DRAWN N/A	CHECKED [illegible]	DATE 7-21-69	APPROVED [illegible]
MATERIAL N/A	TITLE ASSY BRACKET		
FINISH N/A	SIZE A	DWG NO 130-22 CC	REV H

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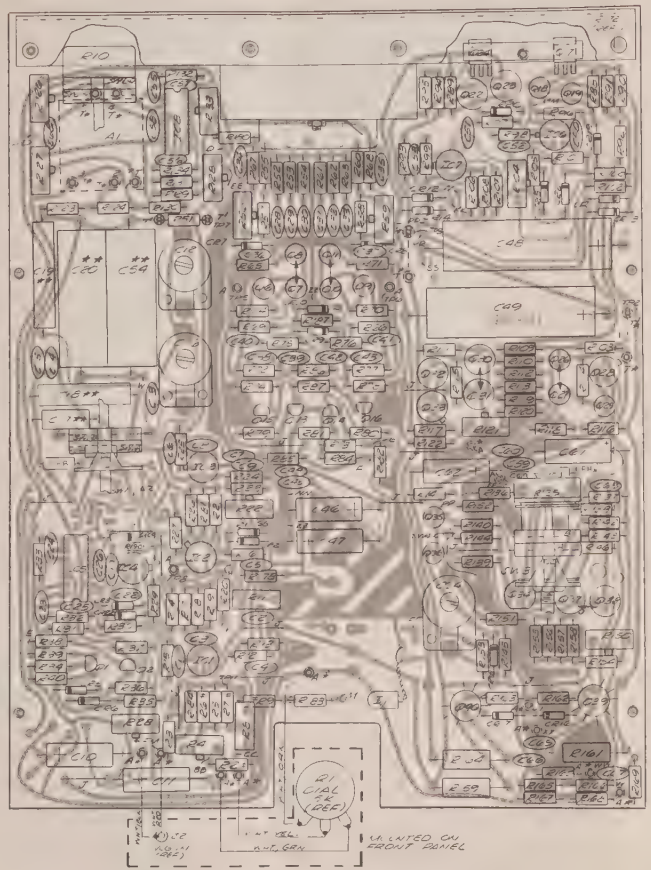
R10
A1
C20
C54
C48
C49
C40
C41
C42
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C44
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C46
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C1
C2
C3
C4
C5
C6
C7
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C93
C94

PARTS LIST

ITEM	REF DES	DESCRIPTION	MFGR	MFGR NO	QTY
		INTEGRATED CIRCUITS			
55	IC1, IC3	LINEAR IC (-13)	FAIRCHILD	µA709C	2
56	IC6, IC7	(-14)		µA709C	2
57	IC4	DUAL TRANSISTOR		MD811	1
58	IC2	4 IN 648 (-18)	FAIRCHILD	CA3039	1
59	IC5	(-163		CA3050	1
60	IC5	(-153)		CA3050	1
61					
62					
63		POTENTIOMETERS			
64	R56, R59	100Ω	CRL	BA1603-B01	2
65	R126,R127	250Ω		-021	2
66	R4, R121 R131	500Ω		-002	3
67	R104	1K		-B03	1
68	R8,R11,R22 R25,R128,R15C	100K		-B14	6
69	R135	1K	WAVETEK	1W 130-SMD ASSY	1
70	R10	10K		130-R1A	1
71					
72	R32,R33	CARBON MF 1% ¼W 249Ω		RN60D	2
73	R162,163	CARBON, ¼W, 5% 8.2Ω	STACKPOLE	RC07GF8R2J	2
74	R38, R39	CARBON, 1/2W, 5% 4.7Ω	STACKPOLE	RC20GF4R7J	2
75	R90,R95	6.8Ω		6R8J	2
76	R86,R87	10Ω		10RJ	3
77	R107	33Ω		33RJ	1
78	R158	56Ω		56RJ	1
79	R17,R26 R37,R42 R155	47Ω		47RJ	5
80	R57,R58 R79,R80	100Ω		100J	4
81	R116,R117	10% 330Ω		331K	2
82	R52,R63	5% 390Ω		390J	2
83	R65,R71 R91,R94	10% 470Ω		471K	4
84	R130,R144	560Ω		561K	2
85	R16	680Ω		681K	1
86	R182	5% 750Ω		751J	1
87	R30,R75 R76,R160	10% 1K		102K	4
88	R35,R85 R98 R99	1.5K		152K	4
89	R54-R56 R100	2.2K		222K	4
90	R24,R73 R112,R115	2.7K		272K	4
91	R13,R101	3.9K		392K	2
92	R88,R89 R92,R93 R96,R97 R107	4.7K		472K	7
93	R55,R62	5% 6.2K		622J	2
94	R178	10% 10K		103K	1
95	R119,R115	18K		183K	2
96	R31,R54 R64	27K		273K	3
97	R28	91K		913K	1
98	R6,R146	220K		224K	2
99	R143	560K		564K	1
100	R29	820K		824K	1
101	R129	1MΩ		105K	1
102	R74,R23	5.6MΩ		565K	2
103	R12	4.7MΩ		475K	1
104	R184	6.8MΩ		685K	1
105	R161,R164	2W, 47Ω		RC42GF470E	2

PARTS LIST

ITEM	REF DES	DESCRIPTION	MFGR	MFGR NO	QTY
		MF, MC, RC, **			
107	R105,R110	METAL FILM, ½W, 1% 2.49K(-1)	CORNING	RN60D	
108	R108,R119	4.02K(-2)			
109		6.19K(-4)			4
110					
111	R103,R106 R108,R111	10K(-4)			
112	R155-R158	METAL FILM, ½W, 1% 18Ω			
113	R159,R160 R162	21.5Ω			3
114	R154	402Ω			
115	R2 ⊕	46.4Ω			
116	R51,R165- R168 /R1,R125 R156	49.9Ω			
117	R105	82.5Ω			1
118	R35	124Ω			
119	R141	140Ω			
120	R134	158Ω			
121	R74,R78 R..	249Ω			
122	R84,R137 R..	316Ω			
123	R55,R60	499Ω			
124	R73,R77	909Ω			
125	R130	1K			
126	R145,R151	1.78K			2
127	R100	2.87K			
128	R84,R70	3.01K			2
129	R120,R122	3.83K			2
130	R66,R68	4.75K			
131	R3,R144	4.99K			2
132	R105	6.19K			
133	R67,R68	6.98K			
134	R.72,R131	8.25K			
135	R152	8.87K			2
136	R5	15K			
137	R103	619K			
138	R9	1M			
139	R159	1W, 6610	IRC	MEC RN70D	
140	R184	1/4W 1000	CORNING	RN60D	
141	R190	⅛W 4.99K		RN56D	1
142	SW1-C, D	WAFER	WAVETEK	130-SW1-3	2
143	SW1-A		CTS	T106	
144	SW1	DETENT	WAVETEK	130-SW1	
145	SW1-B	WAFER		133 SW1-4	
146	SW3	SWITCH		131-SW3A	
147					
148		TRANSISTOR HEATSINK	WAKEFIELD	NF-207	
149		TRANSPADS	M. ROSS	10133M	4
150				10-60	2
151	T	TERMINALS	USECO	20198	
152	T1	BIFURCATED		20008	4
153	B	AMP PINS	AMP	1-162 2	
154	I1	LAMP	MURA	L28/40	
155					
156					
157	CIRCUIT ID CHNDIFICATION		WAVETEK	0130-311	
158	A3	SINE MODULE		B130-011	
159		SRAC SET ASSY		D130-001	
160					
161		SUPPORT BLOCK		B130-328	
162					

PARTS LIST

ITEM	REF DES	DESCRIPTION	MFGR	MFGR NO	QTY
1	C14 ⊕	5%VDCW MICA, 500V, 5% 47PF	GR	DM15-470J	1
2	C13	680PF		680J	1
3	C28, C11	150PF		151J	2
4	C29, C12	300PF		301J	2
5	C10, C31	360PF		361J	2
6	C35	910PF 1%		911F	1
7	C5, C22	CERAMIC DISC, 1000V, 10% +100 -0		DD-100	2
8	C23, C24, C25, ⊕	22PF		DD-220	3
9	C38, C45	33PF		DD-330	2
10	C39, C42 C43 C67, C68	47PF		DD-470	3
11	C37, C68	150PF		DD-151	2
12	C61	330PF		DD-331	1
13	C40, C41	680PF		DD-681	2
14	C31,C8,C10,C31	220PF		DD-221	4
15	C1, C6, C52 C53	50V, 005µF		CK30T	4
16	C65, C66	50V, 01µF		CK-103	2
17	C2, C4, C7 C9, C25, C26 C34 C37 C44, C45 C57-C60	20V, 1µF		UK20-105	16
18	C17	01µF WAVETEK		130-101-4	
19	C18	1µF			1 SET OF 4
20	C19	2µF			
21	C20, C54	4µF			
22	C10, C11, C46,C47 C48,C62	ELECTROLYTIC, 16V, .001µF MALLORY		1500D102B016DC2	6
23	C48, C49	75V 1000 µF		MD1000D35G4	2
24	C12,C16 C34	VARIABLE 4.5-23PF ERIE		561-001-37A	3
25	C56 C70	CERAMIC DISC 1000V 30pF 1KV 100PF CRL DD101	CRL	DD300 DD101	1 1
26		DIODES			
27	CR1-CR10 CR15-CR18 CR21	FD6666	FAIRCHILD	FD6666	15
28	CR11-CR14	SGE-1 SEMTECH		SGE-1	4
29	CR19-CR21	ZENER WAVETEK		130-506B	3
30					
31		TRANSISTORS			
32	Q13, Q16	2N3569	FAIRCHILD	2N3569	2
33	Q33	2N3905A		2N3905 A	1
34	Q40	2N3905A		2N3905A	1
35	Q38	2N3299		2N3299	1
36	Q22, Q23,Q32	2N3638		2N3638	3
37	Q5, Q18 Q19, Q29 Q35, Q36	2N3640		2N3645	6
38	Q14, Q15	L08		L08	2
39	Q39	2N2219A MOTOROLA		2N2219A	1
40	Q6	2N3640		2N3640	1
41	Q1	2N3401		2N3401	1
42	Q2	2N3903		2N3903	1
43	Q17 MODIFIED PER 130-316			TIP29	1
44	Q24			TIP30	1
45	Q34	TO10 SPRAGUE		TO101	1
46	Q37, Q38 MATCHED	2N2904(-A3) FAIRCHILD		2N2905A	1
47	Q30, Q31	2N3638(-A9)		2N3638	2
48	Q7, Q8 Q26, Q27	2N3646(-131)		2N3646	4
49	Q10, Q11	2N3640 .0 MOTOROLA		2N3640	2
50					
51					

SEE SHT 1

REV	DESCRIPTION	BY	DATE	APP
E	ECN 770			
D	ECN 716			
C	ECN 485			
B	ECN 441			
A	ECN 401			

TOLERANCE UNLESS OTHERWISE SPEC
XX ± .01
XXX ± .005
ANGLES ± 0°30'

WAVETEK SAN DIEGO, CALIFORNIA

SCALE N/A
MATERIAL N/A
FINISH N/A

BY GRAY DATE 7-11-73 APP

TITLE
ASSY, MAIN BOARD

MODEL NO. 132
DWG NO. SA 2 0A2
DASH NO. 0132-310
REV 1

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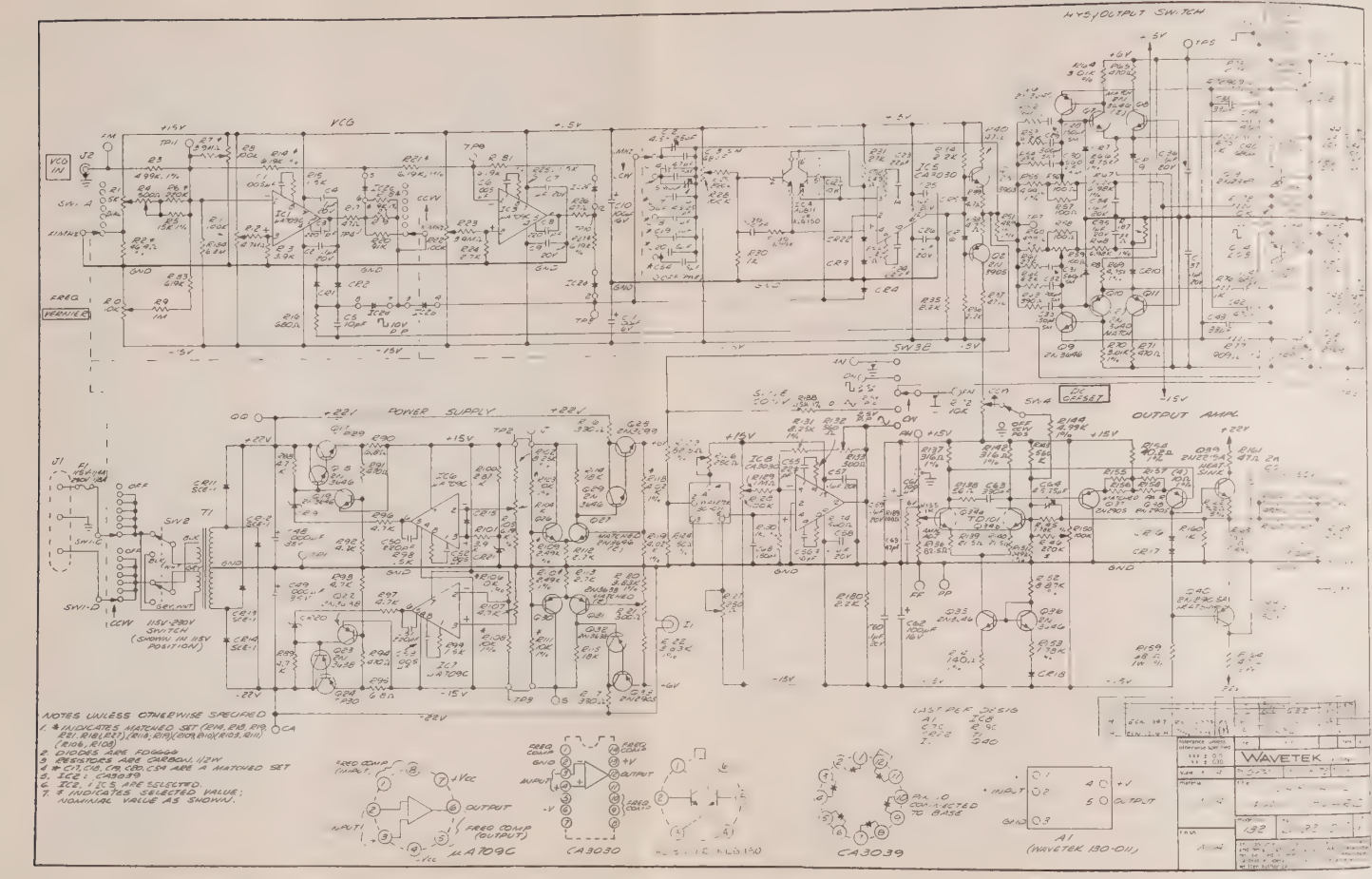
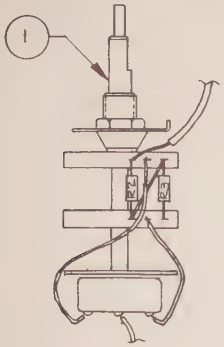
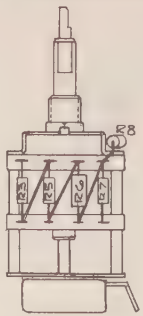
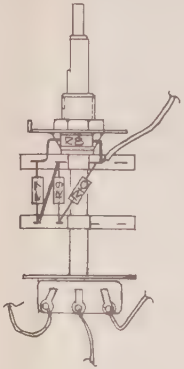

VCG
POWER SUPPLY
OUTPUT AMPL
SYNC OUTPUT SWITCH
115V-230V SWITCH (SHOWN IN 115V POSITION)
NOTES UNLESS OTHERWISE SPECIFIED
1. * INDICATES MATCHED SET (R14, R15, R19, R21, R18)(R23)(R16, R17)(R20)(R10, R11)(R12, R13)(R26, R27)(R28, R29)
2. DIODES ARE FD666
3. RESISTORS ARE CARBON, 1/2W
4. C17, C19, C18, C20, C24 ARE A MATCHED SET
5. IC6 : CA3039
6. IC2, IC5 ARE SELECTED.
7. # INDICATES SELECTED VALUE; NOMINAL VALUE AS SHOWN.
μA709C
CA3030
CA3039
A1 (WAVETEK 130-011)
WAVETEK







PARTS LIST

ITEM	REF DES	DESCRIPTION	MFGR	MFGR NO.	QTY
1		DETENT & WAFER ASSY	WAVETEK	A132-SW2	1
2	R8	RESISTOR, METAL FILM, 1/4W, 1%, 10.0Ω		RNGOD	1
3	R6	21.5Ω		↑	1
4	R5, R10	68.1Ω		↕	2
5	R3, R9	215Ω		↓	2
6	R2, R7	RESISTOR, METAL FILM, 1/4W, 1%, 681Ω		RNGOD	2
7					
8					
9					
10					
11					
12					
13					
14					
15					

TOLERANCES UNLESS OTHERWISE SPEC: XXX .010, XX .030, ANGLES 0°30'

WAVETEK SAN DIEGO CALIF

DRAWN B. Redman DATE 7-2-72 MGR R. C.

MAT'L N/A

MATERIAL N/A

FINISH N/A

TITLE SWITCH ASSY, S/N ATTN

MODEL NO 132 DWG NO B132-001 REV

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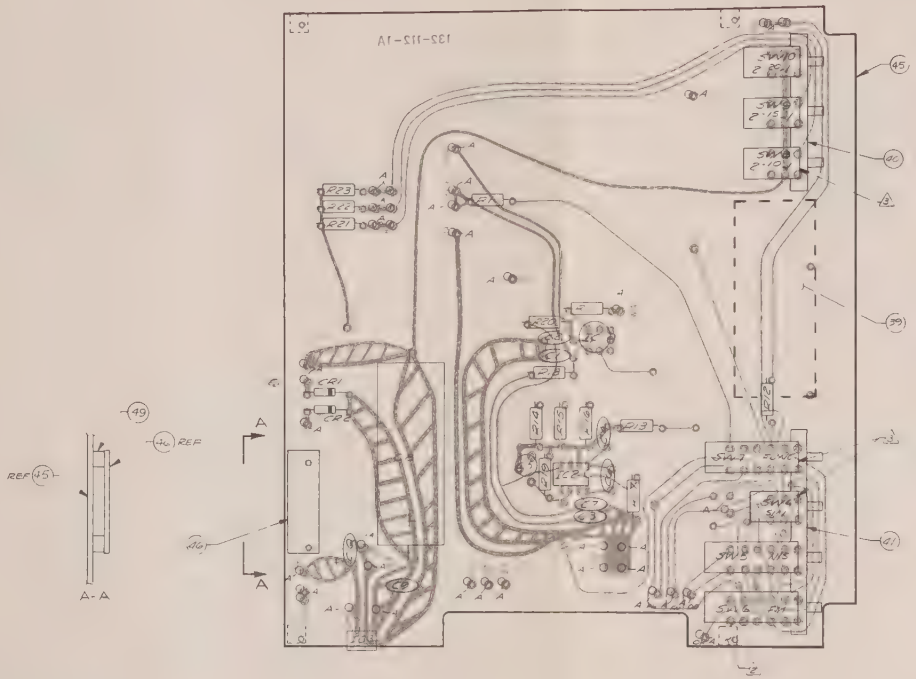
135-115-1A
SW10
SW9
SW8
SW7
SW6
SW5
SW4
SW3
SW2
SW1
CR23
CR22
CR21
CR1
CR2
C7
C8
C9
C10
C11
C12
C13
C14
C15
C16
C17
C18
C19
C20
C21
C22
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R31
R32
R33
R34
R35
R36
R37
R38
R39
R40

REV	ECN	BY	DATE	APP
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

PARTS LIST

ITEM	REF DESIG	DESCRIPTION		MFGR	MFGR P/N	QTY
1		CAPACITORS				
2	[illegible]	CERAMIC DISC [illegible]	[illegible]pF	[illegible]	[illegible]	
3	C4		[illegible]pF		[illegible]	[illegible]
4	C1, C2, C3 C7, C9	10%, 20V,	.1µF		UK20-104	5
5	C10	TANTALUM, 15V,	22µF	SPRAGUE	196D226X0015PB	1
6	C8	ELECTROLYTIC, 15V,	1900µF		39D198G015GL4	1
7	C5	VARIABLE (TRIM)	3.5-13P	STETTNER	75-TRIKO-02	1
8						
9						
10						
11						
12	CR1, CR2	DIODES		[illegible]	SCZ-1	2
13						
14						
15						
16						
17		INTEGRATED CIRCUITS				
18	IC1			SIGNETICS	SG 310	1
19	IC2			NATIONAL SEMI	LM301A	1
20	IC3			FAIRCHILD	7805393	1
21						
22						
23						
24						
25		RESISTORS				
26	R18, R20	METAL FILM, 1/4W, 1%	100	CORNING	RN60D	2
27	R1, R12, R21-R23		[illegible].00K			5
28	R17		[illegible].49K			1
29	R19		6.98K			[illegible]
30	R[illegible]		8.25K			[illegible]

PARTS LIST

ITEM	REF DESIG	DESCRIPTION		MFGR	MFGR P/N	QTY
[illegible]	R13	METAL FILM, 1/4W, 1%	8.87K	CORNING	[illegible]	
[illegible]	R15		15.8K			1
[illegible]	R16		19.1K			1
34	R14		27.4K			1
[illegible]						
[illegible]						
[illegible]						
[illegible]						
39		SWITCH BRACKET, SUBASSY		WAVETEK	C132-003	1
40	SW8-SW10	3 P.B.		WAVETEK	BL12-401	1
[illegible]	SW4-SW7	4 P. B.			-400	1
[illegible]						
[illegible]						
44						
45		CIRCUIT BOARD		WAVETEK	132-112A	1
46		TERMINAL BD ASSY			A133-0/3	1
[illegible]		MOUNTING BLOCK		USECO	1591B	4
48		AMP PINS		AMP	61183-2	37
49		SPACER 1/8"		WAVETEK	8460	2
[illegible]						
[illegible]						
[illegible]						
53						

REV	ECN	BY	DATE	APP
D	771	[illegible]	[illegible]	RC
	ECN 441	[illegible]	[illegible]	RC
E	# 42[illegible]	BE	[illegible]	RC

TOLERANCE UNLESS OTHERWISE SPEC: .XXX .010, .XX .030, ANGLES 0 30	WAVETEK SAN DIEGO CALIFORNIA
SCALE N/A	BY [illegible] DATE [illegible]72 APP RL
MATERIAL N/A	TITLE ASSY AMP BOARD
FINISH N/A	MODEL NO 132 / DWG NO D132-012 SH 2 OF 2 / REV E

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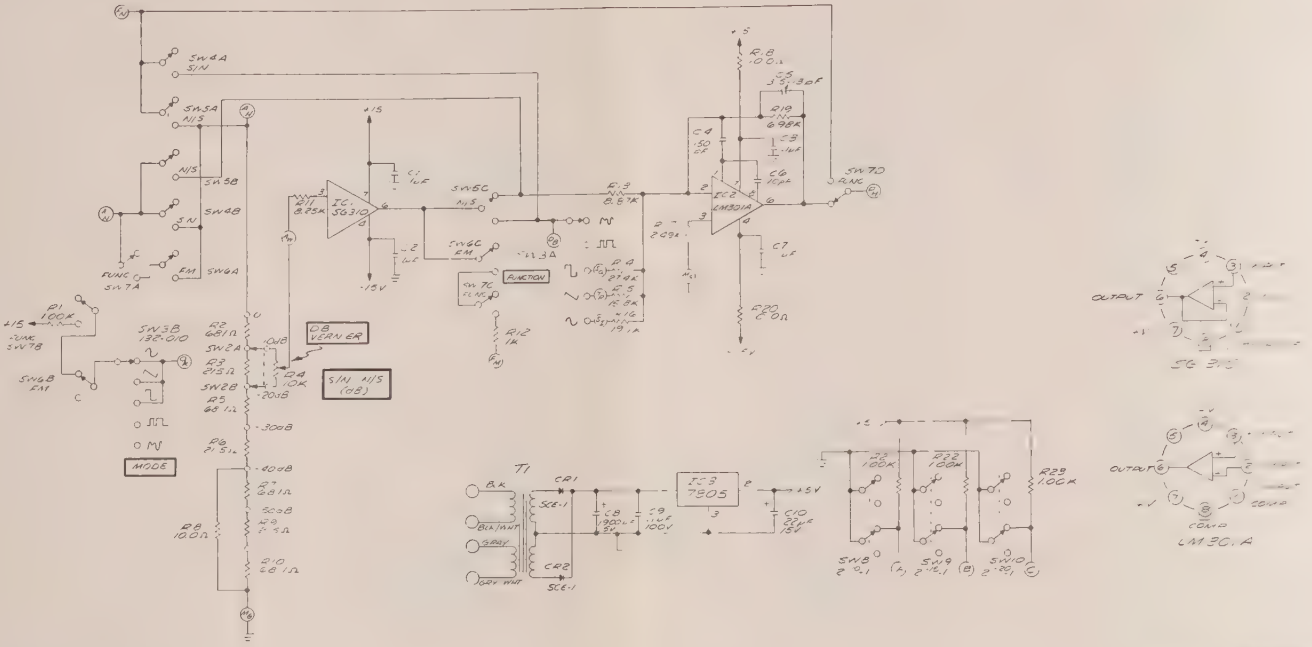


NOTES: UNLESS OTHERWISE SPECIFIED

1. FUN, SIN, NIS INTERLOCKING PUSHBUTTON SWITCHES
2. FM PUSH ON, PUSH OFF
3. ATTENUATOR RESISTORS MOUNTED ON SWITCH
4. ALL RESISTORS ARE METAL FILM, 1/4W, 1%
5. ALL PUSHBUTTON SWITCHES SHOWN IN "OUT" POSITION

LAST REF DESIG

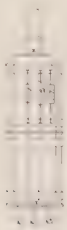
C10	R23
CR2	T1
IC3	SW10

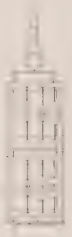
WAVETEK SAN DIEGO, CALIFORNIA

TITLE SCHEMATIC, AMP BOARD

MODEL NO. 132 DWG NO. 0132-212 REV B

THIS DOCUMENT CONTAINS PROPRIETARY INFOR





PARTS LIST

ITEM	SYM DES	DESCRIPTION	MFGR	MFGR NO.	QTY
1		DETENT & WAFER ASSY	WAVETEK	A-132-SWS	1
2					
3	C9	CAPACITOR, SILVER MICA, 5%, 86pf	ARCO	DM15 160J	1
4		.001 μf		DM19 102J	1
5	C5	.015 μf		DM19 153J	1
6	C8	360 pf		DM15 361J	1
7		SILVER MICA, 5%, 270pf		DM15 271J	1
8		POLYSTYRENE, 1%, 01μf	EMB	PA2B103F	1
9		POLYSTERENE, 1%, .1	EMB	PA2B104F	1
10		METAL MYLAR, 10%, .047 μf			
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					

WAVETEK SAN DIEGO CALIFORNIA

SCALE N/A | BY B. Redman | DATE 3-3-72 | APP R. G.

MATERIAL N/A

TITLE SWITCH ASSY, 1-REQ RG

FINISH N/A

MODEL NO. 132 | DRG NO. D132-002 | REV. A

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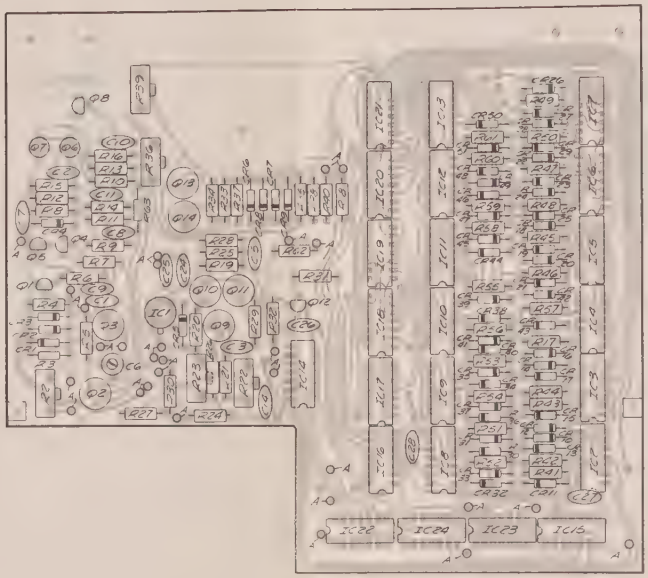


NOTES:

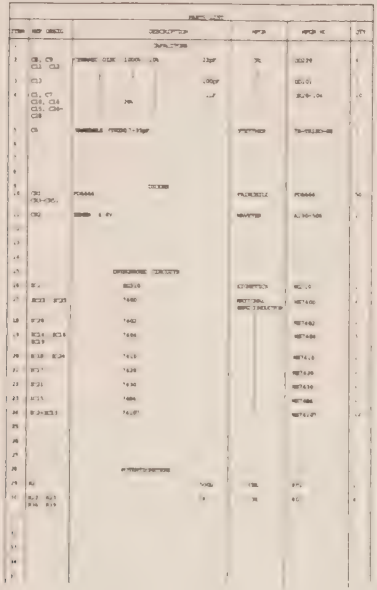
1. A = INSERT AMP PINS (NEARSIDE)
2. USECO BLOCK, SWAGE IN BOARD (NEARSIDE)

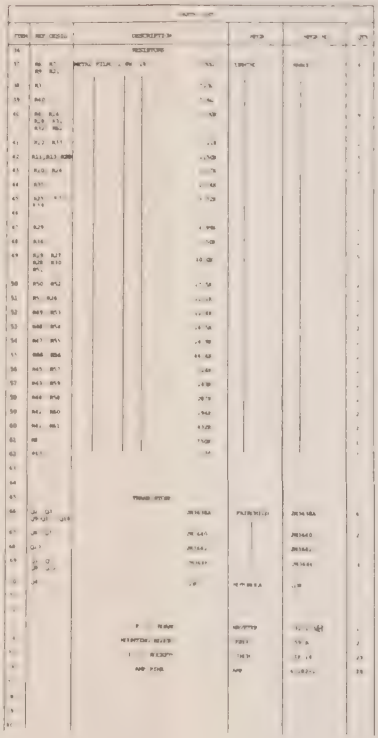
WAVETEK

ASSY LOGIC BOARD

MATERIAL N/A

FINISH N/A

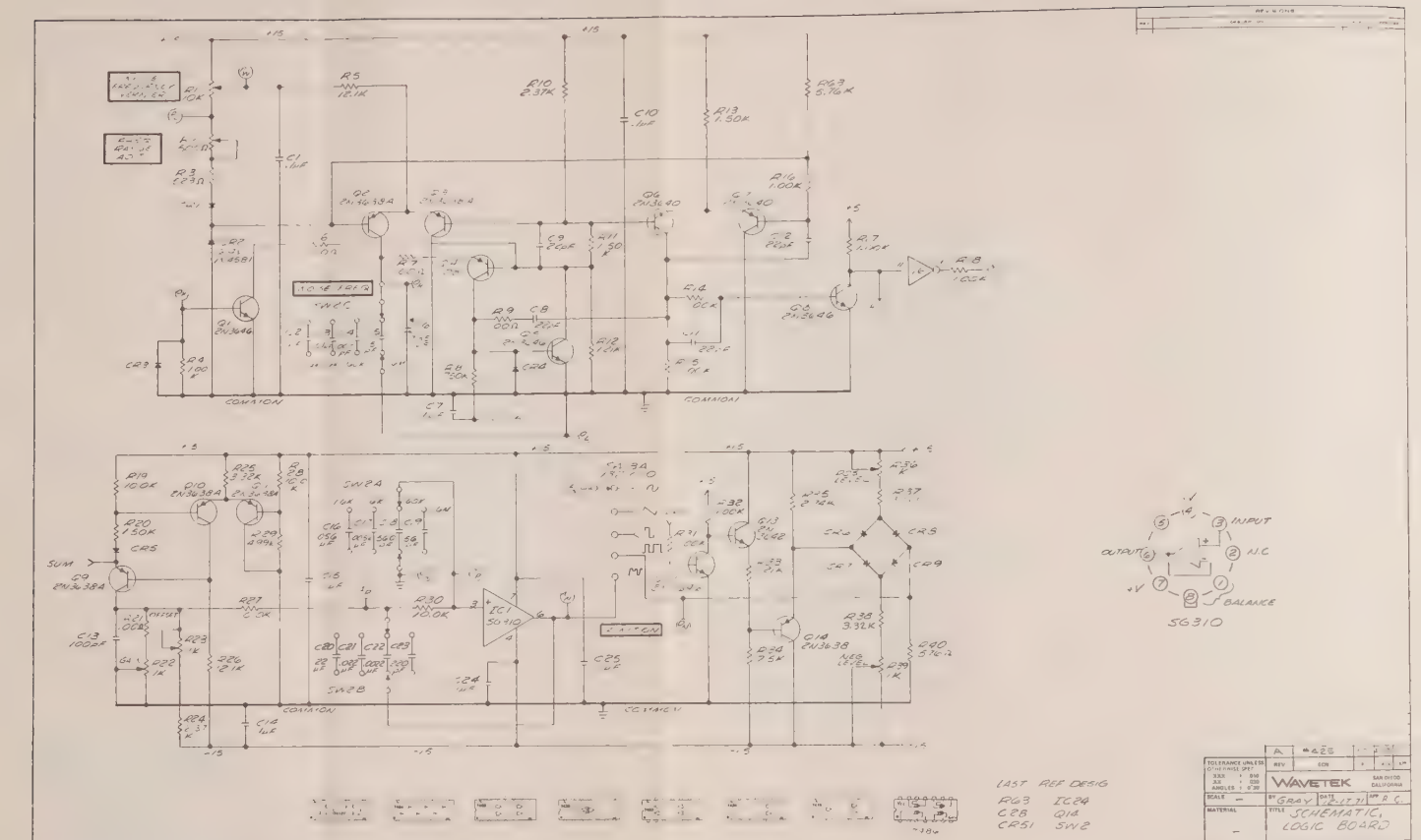




C	484		
A			

WAVETEK

LOGIC BOARD


R1 10K
R5 12.1K
R10 8.37K
C10 .1mF
R13 1.50K
R53 5.76K
R16 1.00K
C1 .1mF
R3 523Ω
Q6 2N3640
Q7 2N3640
C9 .02mF
C8 .02mF
R11 150
R7 1.10K
R8 1.00K
R14 10K
C11 22pF
R9 500Ω
C6 .02mF
R12 1.01K
R15 1K
C5 2N3646
R2 1K
Q1 2N3646
CR3
R4 100K
R6 1K
C7 1mF
COMMON
CHASSIS
SW1A
SW1B
SW2A
SW2B
C16 .05mF
C17 .5mF
C18 .05mF
C19 .5mF
C15 .1mF
R30 100K
IC1 SG-310
C25 .1mF
C24 .1mF
R19 100K
R25 3.32K
R26 3.32K
Q10 2N3638A
Q11 2N3638A
R20 150K
CR5
Q9 2N3638A
SUM
R27 2.05K
R22 1K
R23 1K
R26 2.1K
C13 100pF
R24 4.53K
C14 1mF
R31 100K
Q13 2N3642
R32 100K
R45 2.12K
R37 1.1K
CR4
CR6
CR7
CR8
CR9
R38 3.32K
Q14 2N3638
R39 1K
R40 5.76K
C26 .1mF
R36 10K
C12 .1mF
C27 .1mF
R21 10K
C28 .1mF
C29 .1mF
C30 .1mF
C31 .1mF
C32 .1mF
C33 .1mF
+15
-15
+5
-10
+10
INPUT
N.C.
BALANCE
OUTPUT
+V
-V
SG310
LAST REF DESIG
RG3 IC29
C28 Q14
CR51 SW2
2. ALL RESISTORS ARE METAL FILM, 1/4W, 1%
1. ALL DIODES ARE FD666
NOTES: UNLESS OTHERWISE SPECIFIED
WAVETEK
SAN DIEGO CALIFORNIA
BY J Gray
DATE 2-17-71
APP'D
TITLE SCHEMATIC, LOGIC BOARD
MODEL NO 132
DWG NO 132-213
SHEET 1 OF 2
REV A
MATERIAL —
FINISH —
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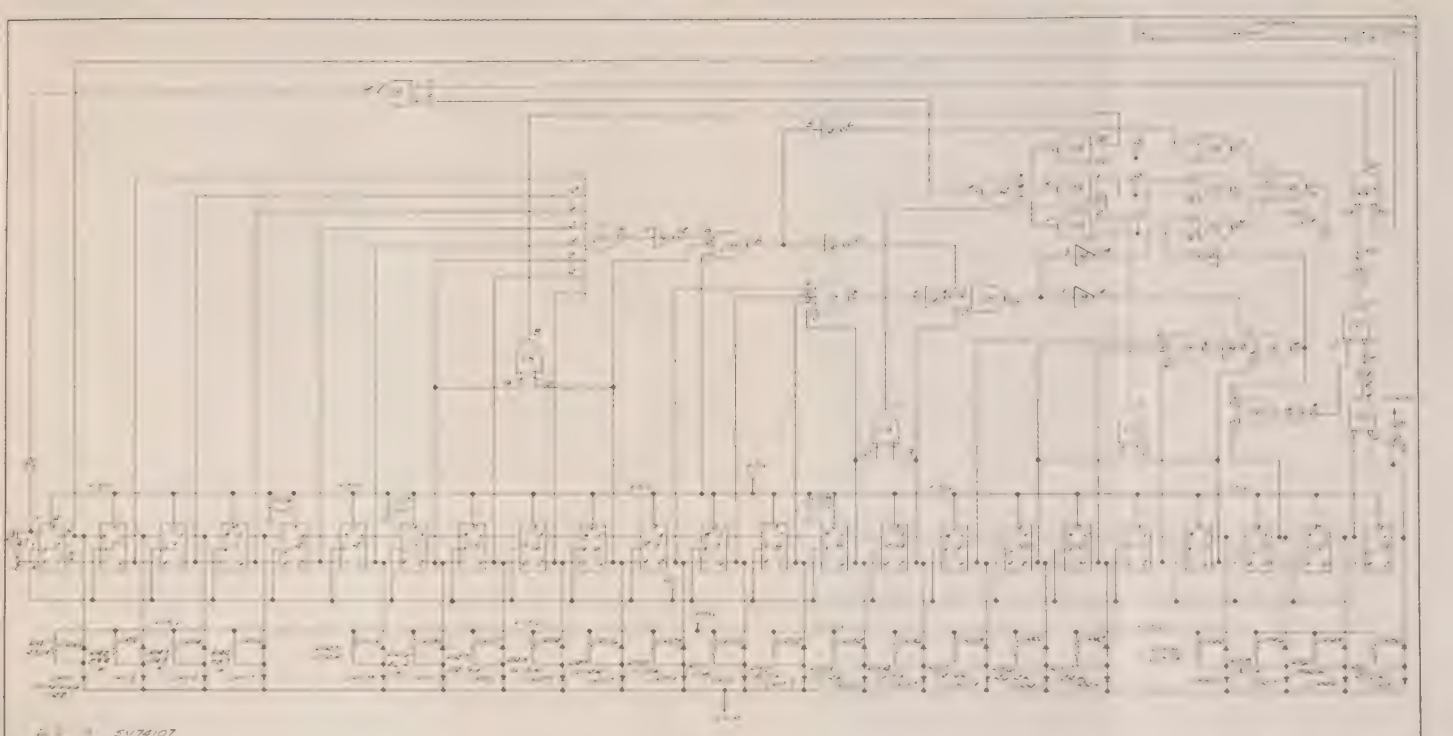


	SN74107
IC14, 16, 19	SN7404
IC22 23	SN 7400
IC21	SN 7430
IC20	SN 7402
IC15	SN 7486
IC17	SN 7420
IC 18, 24	SN 7410

+5 TO PIN 14 ALL IC's

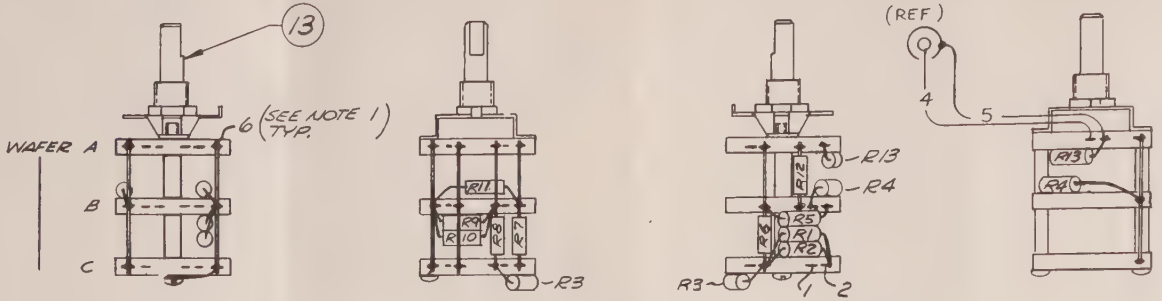
GND TO PIN 7 ALL IC's

NOTES. UNLESS OTHERWISE SPECIFIED

WAVETEK

SCHEMATIC.

LOGIC BOARD



PARTS LIST

ITEM	REF DES	DESCRIPTION	MFGR	MFGR NO.	QTY
1	R4	METALFILM RES 1/4W 1% 54.9Ω	CORNING	RN60D	1
2	R5, R13	59Ω			2
3	R3	27.4Ω			1
4	R11	61.9Ω			1
5	R8	71.5Ω			1
6	R1-R2 R9-R10	196Ω			4
7	R7	249Ω			1
8	R6, R12	825Ω			2
9					
10					
11					
12					
13		DETENT & WAFER ASS'Y	WAVETEK	A136-SW1B	1
14					
15					
16					
17					
18					

NOTES: UNLESS OTHERWISE SPECIFIED

1) NUMBERS INDICATE WIRE TERMINATION POINTS.
FOR MODEL 142 SEE D142-200
FOR MODEL 144 SEE D144-200

REV	ECN	DATE
B	ECN 4408	5/20
A	ECN 3211	5/8

WAVETEK SAN DIEGO, CA

SCALE N/A | DATE 5-20 | BY K.S.

MATERIAL N/A

FINISH N/A

TITLE ASSEMBLY, ATTENUATOR

MODEL 142 144 | DWG # B142-003 | REV B

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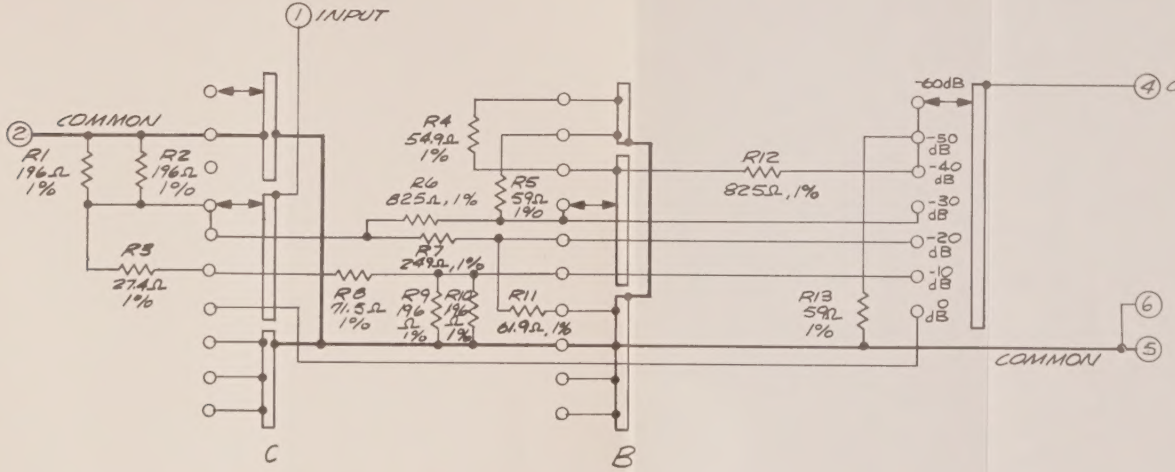

NOTES: UNLESS OTHERWISE SPECIFIED

1. CIRCLED NUMBERS, I.E. ① ETC, INDICATE WIRING INTERCONNECTIONS.
   FOR MODEL 142- SEE 142-200
   FOR MODEL 144- SEE 144-200

REV	ECN	BY	DATE	APP
A	ECN 321			

WAVETEK SAN DIEGO, CALIF.

TITLE: SCHEMATIC ATTENUATOR

DWG NO. 142-203 REV A

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